NORTH CAROLINA'S AERO/SPACE ECONOMY:

Current Performance and Future Potential…Revisited

A Master's Project

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EXECUTIVE SUMMARY

A 2006 white paper authored by the North Carolina Space Initiative suggested that North Carolina had only a "modest" presence in the traditional aerospace industry, i.e. aircraft production, airport operations, etc. However, this present study finds that traditional aerospace is an emerging part of North Carolina's economy with tremendous potential for the state's economic future.

Specifically, this analysis suggests that traditional aerospace is a promising industry for North Carolina because of five primary factors. First and foremost, we find that traditional aerospace firms in North Carolina consistently pay wages well-above the overall state average and in some cases even higher than the national industry average. Second, this study contends that the state has a favorable mix of traditional aerospace industry segments. North Carolina does not have a commanding presence in every facet of the traditional aerospace industry, but the areas the state is strongest in – engine and engine parts manufacturing, replacement parts manufacturing, and maintenance and repair – are growing. Furthermore, North Carolina has become a major player in the emerging very light jet market with the recent addition of HondaJet. Third, we find that the state already has a solid foundation of aerospace-related institutions to build future efforts around including active educational partners such as North Carolina State University and other aerospace-dedicated groups like the North Carolina Aerospace Alliance. Fourth, this study suggests that the traditional aerospace industry provides economic benefit throughout the state. More importantly, we find that the state's industry is especially concentrated in the Triad region, as well as, eastern North Carolina – arguably the two areas of the state in the most need of a new economic direction. Finally, this study feels that traditional aerospace is a good fit for North Carolina because of the state's rich military aviation presence. North Carolina is home to four important military aviation facilities that spawn private sector business such as replacement part production, provide thousands of aerospace-related employment opportunities, and produce traditional aerospace workforce for private firms via retiring personnel. Nonetheless, this study finds that the industry's potential in North Carolina could be threatened by key workforce shortages, especially the state's current lack of skilled machinists.

In addition to traditional aerospace, this study also investigated the potential of the budding commercial space industry to become a part of North Carolina's economic future. And while such a possibility was not ruled out completely, we find that aggressively pursuing commercial space in a meaningful fashion would be a very expensive and risky venture for the state.

INTRODUCTION

North Carolina, like virtually every state in the country, has experienced a dramatic economic transformation in recent years amidst the onset of increased global competition and the continued diffusion of more and more sophisticated technologies. This period has been particularly turbulent for the Tarheel state as North Carolina has seen some its longest standing economic cornerstones – industries such as textiles, furniture, and tobacco – dwindle from the landscape. Nonetheless, the state has weathered the storm rather well and is currently trying to find its place in the new economy. In response, there have been numerous, recent endeavors in the state aimed at trying to identify industries that are seemingly well-suited to become meaningful parts of North Carolina's 21st century economic portfolio.

One such effort is the ongoing work of the North Carolina Space Initiative, an organization which is interested in the potential for the aerospace industry to become a meaningful part of North Carolina's economic future. To that end, a working group published a white paper in January of 2006 entitled "The Aero/Space Economy in North Carolina: A Preliminary Assessment of Current Performance and Future Prospects", which found North Carolina to have only a "modest presence" in the aerospace industry – defined in their report as traditional aerospace activities such as aircraft manufacturing, airport operations, etc (Hardin, 2006, p.16). Nonetheless, their analysis suggested that if the conception of what was considered to be the aerospace industry was somewhat widened, the industry would have a more significant presence in North Carolina, as well as, greater potential for future growth. Ultimately, their analysis concluded that the next logical step was to perform a follow-up study that could explore the issue in much greater detail. Accordingly, this report was funded by the Initiative to serve as the second phase of their initial white paper.

Thus this analysis picks up from where the initial report left off, but with one important caveat. As mentioned, the Initiative's white paper essentially contends that traditional aerospace, by itself, does not appear to have the required potential to be a significant part of the state economy and, therefore, should not be pursued as such. Instead, they suggest casting aerospace as a wider category that would include traditional functions like aircraft

manufacturing, but also other related industries, including the budding area of commercial space activity. Commercial space is defined by the Federal Aviation Administration (FAA) as "the movement of, or means of moving objects, such as communications and observation satellites, to, from, or in space" (FAA, 2007a, par. 2). Essentially, commercial space is about the growing participation of private industry in space operations – a historically public sector-only endeavor. The other far less explored frontier of the commercial space industry is space tourism which focuses on sending private citizens into space for personal pleasure or interest. Nevertheless, the overarching point is that the Initiative's report suggested an expanded notion of aerospace. As a result, they coined the term "aero/space" which will be employed throughout this analysis when referring to the idea of the broader industry, i.e. both traditional aerospace and commercial space applications.

That being said, this analysis will take a slightly different track. Namely, this report will revisit the question of whether or not traditional aerospace, alone, can become a meaningful part of the state economy, instead of taking the previous conclusion as a given. This present analysis believes that developing a more complete understanding of the state's traditional aerospace presence is an important issue and, in turn, will give it the full due diligence it deserves. However, that does not mean that this analysis will ignore the Initiative's broader aero/space concept. In fact, the following report will devote a good deal of its time to exploring the potential that the commercial space industry could hold for North Carolina.

The present study has four fundamental goals. First, it will aim to develop a more complete picture of what North Carolina's traditional aerospace presence actually looks like. Second, based on those results this study will attempt to make a realistic assessment of North Carolina's capacity to expand its aero/space presence and correspondingly, whether or not the industry is a worthy pursuit for the state. Third, we will examine the development experiences of other states where the aero/space industry is already an important part of their economy. And finally, we will use those benchmark findings to gauge whether or not North Carolina's case for aero/space is a realistic one.

More specifically, the paper is divided into four chapters. Chapters one and two will describe North Carolina's current aero/space presence and present an initial round of findings based on that evidence. Chapter three will present the detailed experiences other states have had developing their aero/space industries, while chapter four will revisit the legitimacy of the conclusions presented in the first two chapters in light of the lessons gathered from other states.

LITERATURE REVIEW

The North Carolina Space Initiative's (NCSI) 2006 white paper, "The Aero/Space Economy in North Carolina: A Preliminary Assessment of Current Performance and Future Prospects", suggested that a follow-up, "aerospace-related cluster analysis" be performed and, as a result, the Initiative sponsored this analysis (Hardin, 2006, p. 21). But, before moving on to specific results and conclusions, the following section presents a brief discussion regarding the theoretical foundation on which the following analysis is based.

As mentioned, this study is intended to be a cluster analysis. However, 'cluster analysis' is a kind of amorphous term, meaning that its exact connotation can vary greatly from one study to another. Accordingly, it is very important to define what is meant by 'cluster analysis' with respect to this particular report. To do so, a crucial distinction must first be made regarding cluster analysis. As Bergman and Feser (1999) point out, a cluster analysis is really a two-step process comprised of cluster identification, i.e. figuring out which clusters actually exist in a particular region, and cluster evaluation, i.e. developing a detailed understanding of those identified clusters. This is an especially relevant distinction because this particular study is concerned only with the second step, cluster evaluation, as the identification step was accomplished via the North Carolina Space Initiative's initial interest in the aero/space industry. Accordingly, this report is really more of what Bergman and Feser would refer to as a "highly stylized study of a predetermined sector" than it is a formal cluster analysis (1999, Ch. 3, par. 1). Nonetheless, it is important to note that the literature suggests that performing such an evaluation is an acceptable and commonplace exercise. In fact, Bergman and Feser (1999, Ch. 3 par. 1) note that evaluation studies are typically driven by "specific regional interests or policy concerns" such as the aforementioned white paper. In summary, this study will not attempt to identify specific aero/space clusters present in the state; instead, it will devote its time to the further evaluation of the interests already identified by the North Carolina Space Initiative.

That distinction is also important in terms of selecting specific analytical methods because cluster identification exercises employ a very different set of tools than do

evaluation studies. There are two general categories of evaluation techniques, bottom-up and top-down. Top-down techniques, for example the commonly used location quotient analysis, typically rely primarily on quantitative data and produce more broadly applicable findings. Bottom-up methods, such as expert interviews, generally employ more qualitative sources and consequently tend to generate more detailed, yet, somewhat narrower findings (Cortright 2006). However, each category's strength also tends to be their greatest weakness. For example, top-down methods suffer from a lack of detailed insight and bottom-up methods suffer from a lack of generalizablity. Accordingly, the literature almost unanimously agrees that the best practice is to employ a mix of both methods.

Cortright (2006, p. 36) emphasizes that most cluster analyses "benefit from a balance between top-down/quantitative and bottom-up/qualitative approaches". Benneworth and Henry (2004) echo that sentiment as they advocate employing a range of methods in order to better understand the various forces that influence cluster activity. Feser (2005, p. 2) notes that using a "variety of qualitative and quantitative research designs and specific analytical techniques" is particularly necessary when assessing industry interdependence. And Feser and Luger (2003, p. 15) state that neither quantitative nor qualitative techniques are "without drawbacks", but add that they complement each other nicely when used in concert.

In keeping with that, this study will employ a mix of top-down and bottom-up analytical methods. Specifically, chapter one will rely on quantitative techniques, namely location quotient analysis, as it attempts to provide an updated snapshot of the state's aero/space industry. Chapters two and three, however, will tend to employ more qualitative techniques – especially the expert interview – as they attempt to flesh out the particulars of the overall sketch provided in the first chapter. As a result, hopefully, chapter four can yield some meaningful insights into the true current performance and future potential of North Carolina's aero/space economy.

CHAPTER I: AN INDUSTRY SNAPSHOT

The ultimate goal of this study is to assess the aero/space industry's capacity to be a meaningful part of North Carolina's economic future. But, before this analysis can gauge where the industry might be heading or where it could go, this analysis has to understand where the industry is and where it has been. To that end, chapter one will attempt to answer four fundamental questions. The chapter will begin by trying to determine what segments of the aero/space industry are actually present in North Carolina. Second, this chapter will examine whether or not that presence has changed in recent years, i.e. does the state's presence appear to be growing, declining, stagnant, etc. Third, this chapter will inject the issue of quality of into the discussion by assessing whether or not the opportunities that do currently exist appear to reap benefits for the state of North Carolina and its citizens. And finally, chapter one will evaluate how the aero/space presence that does exist in North Carolina is distributed within the state.

Then, building on the quality of job discussion, the second part of this chapter will look to add another level of detail to the current snapshot of the industry by examining the aero/space industry in terms of its occupational composition.

However, before delving into specific results, it is important to take care of some definitional housekeeping. This issue was touched on very briefly in the preceding introduction, but it merits further elaboration because it is a vitally important part of understanding the overall structure of this analysis. The aforementioned North Carolina Space Initiative (NCSI) white paper dealt with the aero/space industry on three levels. First, their analysis addressed what was referred to as the "aerospace industry", which is the somewhat narrowly defined traditional conception of aerospace, i.e. building planes and running airports (Hardin, 2006, p.5). Second, their analysis discussed a much broader vision of aerospace, a level that they referred to as "aerospace-related clusters" which includes the commercial space industry (Hardin, 2006, p.6). Finally, the NCSI white paper included an even more all-encompassing vision of aerospace which they coined the "aero/space economy" (Hardin, 2006, p.7). But, as discussed in the introduction, this analysis is organized a bit differently. To recap, this report will address only two main areas. Its primary focus will be to revisit the current performance and future potential of

the state's traditional aerospace industry. Additionally, this analysis will examine the possibilities for North Carolina to become involved in more cutting edge areas of aerospace, namely, the commercial space industry. Accordingly, this analysis will employ three different definitions. The first term that will be used is "traditional aerospace". Traditional aerospace will be used in the same capacity that "aerospace industry" was employed in the NCSI white paper, namely, to represent conventional functions of aerospace such as aircraft manufacturing and commercial airline operations. Second, as discussed in the introduction, the term "commercial space" will be employed to represent the emerging areas of commercial space transportation and tourism. Finally, this analysis will use NCSI's "aero/space" term when discussing the two areas – traditional aerospace and commercial space – together.

That being said, it is important to note that the analysis in chapter one will focus solely on traditional aerospace. As mentioned, this study will address commercial space, however, due to its emerging nature; historical data analysis is unlikely to yield any meaningful insights. Instead, the question of commercial space will be addressed in full in subsequent chapters, especially chapters three and four.

With that established, it is time to turn the attention to the real focus of chapter one, i.e. developing an updated and more detailed snapshot of North Carolina's traditional aerospace industry. Using the definition employed in the NCSI white paper, traditional aerospace is defined as "those industries that directly create aerospace and aviation products and services" excluding "those components of the military that are engaged in aerospace and aviation-related activities" (Hardin, 2006, p.5). Even more specifically, traditional aerospace is comprised of the 17 North American Industry Classification System (NAICS) codes shown in Table 1.1 below.

Table 1.1 – Traditional Aerospace Industry NAICS Codes

334511 Search, Detection, and Navigation Instruments Manufacturing
336411 Aircraft Manufacturing
336412 Aircraft Engine and Parts Manufacturing
336413 Other Aircraft Parts and Auxiliary Equipment Manufacturing
336414 Guided Missile and Space Vehicle Manufacturing

336415 Space Vehicle Propulsion Units and Parts Manufacturing

336419 Other Guided Missiles and Space Vehicles Manufacturing

481111 Scheduled Passenger Air Transportation

481112 Scheduled Freight Air Transportation

481211 Nonscheduled Chartered Passenger Air Transportation

481212 Nonscheduled Chartered Freight Air Transportation

481219 Other Nonscheduled Air Transportation

488111 Air Traffic Control

488112 Other Airport Operations

488190 Other Support Activities for Air Transportation

517410 Satellite Communications

611512 Flight Training Schools

Source: "The Aero/Space Economy in North Carolina"

The first step in developing an updated snapshot is determining from the economic data which segments of traditional aerospace are currently present in North Carolina. Using Quarterly Census of Employment and Wages (QCEW) data from the Bureau of Labor Statistics and the Employment Security Commission of North Carolina, this analysis will gauge traditional aerospace's presence by examining employment and establishment figures. Starting with the industry's presence in terms of employment, Table 1.2 presents North Carolina's employment totals in each of the previously identified traditional aerospace NAICS industries in 2001 and 2005, as well as, the percentage change in those totals during that period.[1]

The first result of note from Table 1.2 is that 14 of the 17 identified industries registered any presence in North Carolina. According to the data, NAICS codes 336414, 336415, and 336419, essentially all the space vehicle and missile manufacturing, are not part of the state's aerospace portfolio. Nonetheless, the state does have a presence in the other fourteen with the largest concentration as of 2005 in scheduled air transportation (481111) which essentially represents all the commercial airline operations in the state. North Carolina also appears to have a sizable presence in airport operations (488119),

[1] The data are end of the year totals for private industry only in 2001 and 2005. 2005 was used because it was the most recent year where comparable North Carolina and U.S. data could be obtained, which was required to complete the location quotient analysis presented in Tables 1.2 and 1.3.

aircraft repair and maintenance[2] (488190), and aircraft engine and engine parts manufacturing (336412).[3] Conversely, the state appears to have very little presence in nonscheduled cargo operations (481212) and satellite communications (517410).

However, looking at raw employment totals out of context can be misleading. Accordingly, Table 1.2 includes the location quotients for each of the fourteen industries.[4] Using that information, the largest relative employment concentration in North Carolina is airport operations (1.30) followed closely by aircraft maintenance and repair (1.06). In fact, those areas were the only two found to have location quotients over 1.0. Moreover, scheduled passenger transportation, which had by far the largest presence in terms of raw numbers, has a location quotient of only 0.90, which is more in line with what would be expected in a state of North Carolina's size as opposed to a disproportionate concentration. Likewise, aircraft engine and engine parts manufacturing, the other industry segment which appeared to have a strong presence based on raw numbers alone, registered a fairly low location quotient (0.54) in 2001, though that figure rose significantly to 0.74 in just four years. Other industry segments of note based on the location quotient analysis include scheduled freight operations and nonscheduled passenger operations which both saw their quotients increase between 2001 and 2005. On the opposite end of the spectrum, aircraft manufacturing and satellite communications both registered fairly low levels of concentration with location quotients of 0.07 and 0.11 respectively.

Nevertheless, one final piece of context is needed to really gain a complete hold on the data. Location quotients add the relative comparison aspect, but they do not control overall increases and/or decreases in whatever they are measuring. For example, an

[2] Based on NAICS' own description of the industry, this analysis will often refer to Other Support Activities for Air Transportation as Aircraft Maintenance and Repair in order to add some much needed meaning to a rather generic title.

[3] Full detailed descriptions of each NAICS code can be found in the appendix.

[4] A location quotient is a measure of relative size. Specifically, it compares the concentration of a particular quantity (in this case employment and establishments) in a particular region (North Carolina) against a benchmark region (the U.S.). It is calculated as: (industry employment in NC/total employment in NC) / (industry employment in US / total employment in US). A location quotient of 1.0 would indicate that the share of industry employment in North Carolina matches the comparable share for the U.S. Location quotients significantly above 1.0 suggest the state *might be* specialized in that given industry.

industry may register a huge jump in its location quotient from one year to another, but that increase could be due simply to the fact that the industry in the state did not decline as much as did the industry in the nation. Accordingly, Table 1.2 includes the percent change in each industry segment for both North Carolina and the U.S. between 2001 and 2005. Looking at those numbers it appears that despite some low location quotients and seemingly unimpressive employment levels, the state experienced growth in eight out of the fourteen industries. However, in aggregate, traditional aerospace employment decreased during the four-year period driven by sharp losses in scheduled passenger transportation. But, that result should be taken with a grain of salt because it was undoubtedly triggered by the fallout from the tragic events of September 11th, 2001. In fact, when scheduled passenger transportation is removed, North Carolina actually appears to have experienced a nearly thirteen percent increase in traditional aerospace employment between 2001 and 2005, whereas, with the same omission, the national total decreased nearly six percent. That growth in the state was fueled by sizable increases in aircraft manufacturing, aircraft engine and engine part manufacturing, instrument manufacturing, scheduled freight operations, nonscheduled passenger transportation, aircraft maintenance and repair, satellite communications, and flight school training. Making that result even more impressive is the fact that five of those eight increases occurred while the corresponding national totals declined.

In summary, looking at the employment levels alone, the Space Initiative's description of North Carolina's traditional aerospace industry presence as "modest" appears to be a fair assessment, given that the industry as of 2005 comprises less than one percent of total state employment (Hardin, 2006, p.16).[5] Nonetheless, when at least partially controlling for the recent instability in commercial airline industry, the data suggest that traditional aerospace is growing in North Carolina. In fact, growth in traditional aerospace without commercial airline operations (12.84%) far outpaced overall employment growth in the state (0.49%) between 2001 and 2005. Furthermore, the state appears to be particularly well-positioned in aircraft engine and engine part manufacturing (336412) and aircraft

[5] Calculation: total employment in traditional aerospace divided by total state employment – 20,918/3,208,940=0.65%

maintenance and repair (488190) based on their sizable raw numbers, solid growth, and promising location quotients.

Table 1.2 – Traditional Aerospace Employment in North Carolina: Totals, Percent Change, and Location Quotients

NAICS Industry	Employment Total		Percent Change 01-05		Location Quotient	
	2001	2005	North Carolina	United States	2001	2005
Search, Detection, and Navigation Instrument Manufacturing – 334511	551	580	5.26%	4.79%	0.13	0.13
Aircraft Manufacturing – 336411	134	403	200.75%	-11.32%	0.02	0.07
Aircraft Engine and Engine Parts Manufacturing – 336412	1,501	1,750	16.59%	-13.65%	0.54	0.74
Other Aircraft Parts and Auxiliary Equipment Manufacturing – 336413	659	447	-32.17%	-11.05%	0.23	0.18
Scheduled Passenger Air Transportation – 481111	16,971	11,497	-32.26%	-20.17%	1.05	0.90
Scheduled Freight Air Transportation – 481112	71	174	145.07%	-16.76%	0.16	0.46
Nonscheduled Chartered Passenger Air Transportation – 481211	206	774	275.73%	5.79%	0.21	0.77
Nonscheduled Chartered Freight Air Transportation – 481212	33	31	-6.06%	-14.95%	0.13	0.14
Other Nonscheduled Air Transportation – 481290	204	30	-85.29%	-46.30%	1.83	0.51
Air Traffic Control – 488111	89	43	-51.69%	-50.18%	0.58	0.57
Other Airport Operations – 488119	2,541	2,324	-8.54%	2.45%	1.45	1.30
Other Support Activities for Air Transportation – 488190	2,219	2,578	16.18%	11.02%	1.00	1.06
Satellite Communications – 517410	33	53	60.61%	-22.93%	0.05	0.11
Flight Training – 611512	108	234	116.67%	-17.81%	0.18	0.48
TOTAL	**25,320**	**20,918**	**-17.39%**	**-11.47%**	**0.62**	**0.59**

Source: Bureau of Labor Statistics' Quarterly Census of Employment and Wages

In an effort to provide a more comprehensive snapshot of the state's traditional aerospace presence, Table 1.3 provides an analysis similar to Table 1.2 that looks at the industry in terms of establishments instead of employment. Among other things, using establishment

data, we can ask whether the industry is dominated by several large companies or is comprised of a number of small to mid-sized firms.

In terms of raw numbers of establishments, aircraft maintenance and repair had the largest presence in the state as of 2005 with 80 establishments followed by scheduled passenger services and airport operations with 51 and 47 respectively. Looking at the location quotient figures, only three of the fourteen industries had values of 1.0 or greater in 2005 and all three of those values had decreased since 2001. With respect to percentage change, eight industries saw their total number of establishments decrease, two had no change, and four industries experienced establishment growth during the four-year span.

In terms of insights into establishment size, data suppression due to confidentiality issues does not allow us to calculate certain indicators. Nonetheless, in general, it appears that the number of workers per firm is higher in traditional aerospace than it is in the overall state economy with around 65 employees per establishment in aerospace compared to only around fourteen employees per establishment for the state as a whole.[6] And while that is a fairly rough calculation, the pattern is the same for the U.S. with approximately 70 workers per establishment in traditional aerospace compared to only around thirteen per establishment in the total U.S. economy.[7] In summary, it appears that traditional aerospace establishments do tend to be larger – a result that seems to make sense when taking into account the economies of scale present in many of the industry's key segments such as commercial airline operation and aircraft production.

Overall, Table 1.3 presents a fairly similar picture to the employment analysis. For example, traditional aerospace establishments, like traditional aerospace employment, comprise less than one percent of total establishments in the state.[8] But, unlike the employment situation, the number of traditional aerospace establishments in the state

[6] Calculation: total employment for both traditional aerospace and entire state divided by total number of establishments for each – 20,918/319=65.5 and 3,208,940/225,901=14.2, respectively
[7] Calculation: total employment for both traditional aerospace and entire U.S. divided by total number of establishments for each – 1,228,664/17,561=69.9 and 110,611,016/8,294,662=13.1, respectively
[8] Calculation: total establishments in traditional aerospace divided by total state establishments – 319/225,901=0.14%

decreased between 2001 and 2005 while the total for the state in all industries increased nearly five percent. The two bright spots from the employment analysis – aircraft engine and engine part manufacturing and aircraft maintenance and repair – did not fare quite as well in the establishment analysis. Yet, maintenance and repair did account for over a quarter of all the state traditional aerospace establishments in 2005 and was one of only four industries to experience establishment growth during the four-year span from 2001 to 2005. All in all, in terms of establishments, North Carolina's traditional aerospace presence does appear rather "modest" (Hardin, 2006, p.16).

Table 1.3 – Traditional Aerospace Establishments in North Carolina: Totals, Percent Change, and Location Quotients

NAICS Industry	Establishment Total		Percent Change 01-05		Location Quotient	
	2001	2005	North Carolina	United States	2001	2005
Search, Detection, and Navigation Instrument Manufacturing – 334511	8	8	0.00%	2.60%	0.34	0.34
Aircraft Manufacturing – 336411	5	5	0.00%	32.70%	0.38	0.29
Aircraft Engine and Engine Parts Manufacturing – 336412	11	10	-9.09%	-1.15%	0.65	0.61
Other Aircraft Parts and Auxiliary Equipment Manufacturing – 336413	9	8	-11.11%	-11.97%	0.21	0.21
Scheduled Passenger Air Transportation – 481111	53	51	-3.77%	-5.27%	0.77	0.81
Scheduled Freight Air Transportation – 481112	13	11	-15.38%	10.58%	0.77	0.60
Nonscheduled Chartered Passenger Air Transportation – 481211	26	31	19.23%	6.42%	0.46	0.53
Nonscheduled Chartered Freight Air Transportation – 481212	9	11	22.22%	1.39%	0.56	0.69
Other Nonscheduled Air Transportation – 481290	20	13	-35.00%	-20.55%	1.63	1.37
Air Traffic Control – 488111	15	6	-60.00%	-11.16%	2.40	1.11
Other Airport Operations – 488119	53	47	-11.32%	-4.88%	1.16	1.11
Other Support Activities for Air Transportation – 488190	76	80	5.26%	9.56%	0.72	0.71
Satellite Communications – 517410	13	12	-7.69%	-5.95%	0.44	0.44
Flight Training – 611512	19	26	36.84%	0.56%	0.63	0.88

NAICS Industry	Establishment Total		Percent Change 01-05		Location Quotient	
	2001	2005	North Carolina	United States	2001	2005
TOTAL	**330**	**319**	**-3.33%**	**0.99%**	**0.68**	**0.67**

Source: Bureau of Labor Statistics' Quarterly Census of Employment and Wages

With a general understanding of traditional aerospace employment and establishment presence in place, the next question that arises is whether or not the opportunities that exist are quality positions – a particularly important issue in assessing whether or not North Carolina should target the industry. In this analysis, average annual pay as determined by the Bureau of Labor Statistics will serve as a proxy for job quality.[9] Specifically, Table 1.4 lists the average annual pay for each of the fourteen industries in North Carolina, the difference between that figure and the national average, as well as, the change in average annual pay during the four-year span between 2001 and 2005.

The headlining result from Table 1.4 is that the average annual pay for the traditional aerospace industry in North Carolina is considerably higher than the average annual pay for the state as a whole.[10] In fact, in 2005 the average pay in traditional aerospace was more than 30 percent higher than the overall average for the state – $46,582 compared to $35,764. Furthermore, that finding does not appear to be the result of just a handful of really well-paying industry segments driving up the average as, in 2005, thirteen out of the state's fourteen traditional aerospace industry segments registered average pay levels above the overall state mark. However, Table 1.4 reveals that average annual pay in traditional aerospace did not grow nearly as much as it did in the North Carolina economy as a whole – a less than one percent increase in traditional aerospace compared to a twelve percent increase in the overall North Carolina pay level. But, as was the case with traditional aerospace employment, this result seems to have been caused at least in part by the aftermath of September 11th. In fact, if the pay data for scheduled commercial passenger transportation is removed from the equation altogether, i.e. for both years, then

[9] Average annual pay is computed by dividing total annual pay of employees covered by unemployment insurance programs by the average monthly number of these employees. In addition to salaries, average annual pay data include bonuses, the cash value of meals and lodging when supplied, tips and other gratuities, and, in some states, employer contributions to certain deferred compensation plans such as 401(k) plans, and stock options.

[10] Average annual pay for the entire traditional aerospace industry was calculated as a weighted average of its fourteen industry segments.

the average annual pay in North Carolina's traditional aerospace industry is found to increase nearly 24 percent between 2001 and 2005 – nearly double the growth in the overall state level for the same period. Additionally, once the same adjustment is made for the U.S. industry, it is revealed that the average annual pay in North Carolina's traditional aerospace industry even experienced a larger percentage increase than did the national mark for the four-year period between 2001 and 2005 – average annual pay in North Carolina's industry increased 23.79 percent while the national level only increased 18.71 percent.

The high water mark for an individual industry segment was in aircraft engine and engine parts manufacturing with an average annual pay in 2005 of $79,055. Furthermore, as of 2005 that level was $11,199 higher than the national average for that same industry and its percentage change increase between 2001 and 2005 in North Carolina was roughly double what it was for the national industry. Other individual industry segments of note include other aircraft part manufacturing which experienced a 52.6 percent increase between 2001 and 2005 and other nonscheduled air transportation which more than doubled its average annual pay during that same period.

Table 1.4 – Average Annual Pay in Traditional Aerospace Industries in North Carolina

NAICS Industry	Average Annual Pay		Difference between North Carolina and United States (NC minus US)		Percent Change 01-05	
	2001	2005	2001	2005	North Carolina	United States
Search, Detection, and Navigation Instrument Manufacturing – 334511	$51,079	$55,976	-$18,491	-$27,774	9.59%	20.38%
Aircraft Manufacturing – 336411	$40,254	$53,037	-$22,222	-$24,098	31.76%	23.46%
Aircraft Engine and Engine Parts Manufacturing – 336412	$62,158	$79,055	$2,676	$11,199	27.18%	14.08%
Other Aircraft Parts and Auxiliary Equipment Manufacturing – 336413	$46,081	$70,331	-$3,855	$13,659	52.62%	13.49%
Scheduled Passenger Air Transportation – 481111	$48,595	$41,936	-$4,220	-$10,484	-13.70%	-0.75%
Scheduled Freight Air Transportation – 481112	$31,308	$27,531	-$15,291	-$22,405	-12.06%	7.16%

NAICS Industry	Average Annual Pay		Difference between North Carolina and United States (NC minus US)		Percent Change 01-05	
	2001	2005	2001	2005	North Carolina	United States
Nonscheduled Chartered Passenger Air Transportation – 481211	$39,774	$43,503	-$3,966	-$10,837	9.38%	24.23%
Nonscheduled Chartered Freight Air Transportation – 481212	$45,895	$40,208	$3,375	-$10,985	-12.39%	20.40%
Other Nonscheduled Air Transportation – 481290	$21,209	$49,610	-$15,664	-$4,276	133.91%	46.14%
Air Traffic Control – 488111	$42,214	$63,628	$10,107	$14,222	50.73%	53.88%
Other Airport Operations – 488119	$37,771	$43,176	$13,243	$16,909	14.31%	7.09%
Other Support Activities for Air Transportation – 488190	$33,541	$43,619	-$3,765	-$1,290	30.05%	20.38%
Satellite Communications – 517410	$52,449	$58,366	-$9,089	-$16,513	11.28%	21.68%
Flight Training – 611512	$28,369	$37,749	-$7,853	-$3,941	33.06%	15.10%
INDUSTRY TOTAL	$46,490	$46,582	-$6,911	-$13,157	0.20%	11.87%
OVERALL TOTAL	$31,910	$35,764	-$4,247	-$4,741	12.08%	12.03%

Source: Bureau of Labor Statistics' Quarterly Census of Employment and Wages

Thus far, this chapter has provided some insights on what parts of the traditional aerospace industry are present in North Carolina, how that presence has changed during the last few years, and a general idea about how well the industry pays. What hasn't been addressed yet is the question of location. More specifically, this analysis wants to know how the traditional aerospace activity that is present in the state is distributed geographically, i.e. is all the activity concentrated in one area or region of the state or does the industry generate economic activity throughout North Carolina – this may be a particularly important issue when ultimately considering whether or not expansion of the industry is worth pursuing. For example, is traditional aerospace benefiting areas of the state that are already very successful such as the Research Triangle or is it providing benefit in regions that are in greater need of a new economic engine such as eastern North Carolina.

Unfortunately, such questions are much easier to ask than they are to answer. Confidentiality concerns and the corresponding suppression of data make it somewhat difficult to develop a truly complete picture of the industry's geographic distribution in

the state. Nonetheless, there are some available data and, while it does not tell the whole story, it does provide some initial insights. In addition, it should be noted that this important question will also be addressed further in the next chapter albeit in a more qualitative fashion.

That being said, Table 1.5 presents the relevant published data that are available. Specifically, the table shows the available, unsuppressed four-digit NAICS code employment data for each of North Carolina's seven economic development partnership regions[11] as of the second quarter of 2006.[12] The first result that emerges from the chart is that there seems to be at least some traditional aerospace activity in each of the seven regions, though the available data suggest that the industry's presence is fairly light in the western corner of the state. On the other end of the spectrum, the Charlotte and Piedmont Triad regions both appear to have sizable concentrations of traditional aerospace activity as do the Southeast and Research Triangle regions. However, closer inspection reveals that the bulk of the activity in both the Charlotte and Research Triangle regions is in scheduled air transportation – undoubtedly a result of the major airports located in each area. Conversely, the activity in the Piedmont Triad and Southeast regions seems to be based on other somewhat more promising segments of the traditional aerospace industry. The Piedmont Triad is shown to have 2,495 employees in support activities for air transport which is the grouping that houses aircraft maintenance and repair. Similarly, the Southeast region's activity seems to center around the manufacturing segment of the industry, which like maintenance and repair, has been a fairly consistent bright spot thus far. While data suppression prevents firm conclusions, we can begin to form a general

[11] A map of the seven economic development partnership regions is included in the appendix.

[12] Four-digit NAICS codes were used in Table 1.4 in an effort to try and provide as full a picture as possible, i.e. to get around data suppression issues that come into play at a six-digit level. The consequence of doing so is the loss of some detail; however, the goal of the table is just to provide some idea of regional activity so detail isn't as important in this case. Essentially what has happened by going up to a higher level, i.e. four-digit instead of six, is that the component industries under each four-digit code have simply been aggregated together. For example, all the aircraft manufacturing industries are now all summed up together under aerospace product and parts manufacturing. Unfortunately, this necessary step eliminates the analysis' ability to address instrument manufacturing, satellite communications, and flight training schools because their four-digit groupings include a whole array of other activities unrelated to traditional aerospace. Hence, including them would greatly skew the results. On a related note, this is also the same logic that is employed with the occupational analysis at the end of this chapter.

idea of what areas appear to be more active than others, as well as, some insight into their respective specializations.

Table 1.5 – Geographic Distribution of North Carolina's Traditional Aerospace Industry by Regional Economic Development Partnership Region

Regional Partnership	NAICS Grouping	NAICS Code	2Q:06 Employment
Advantage West	Support Activities for Air Transport	4881	80
			Total: 80
Charlotte	Aerospace Product & Parts Manufacturing	3364	565
Charlotte	Scheduled Air Transportation	4811	5,374
Charlotte	Nonscheduled Air Transportation	4812	111
Charlotte	Support Activities for Air Transport	4881	556
			Total: 6,606
Eastern	Support Activities for Air Transport	4881	738
			Total: 738
Northeast	Support Activities for Air Transport	4881	770
			Total: 770
Southeast	Aerospace Product & Parts Manufacturing	3364	1,465
Southeast	Scheduled Air Transportation	4811	127
Southeast	Nonscheduled Air Transportation	4812	10
Southeast	Support Activities for Air Transport	4881	519
			Total: 2,121
Piedmont Triad	Aerospace Product & Parts Manufacturing	3364	203
Piedmont Triad	Scheduled Air Transportation	4811	2,947
Piedmont Triad	Support Activities for Air Transport	4881	2,495
			Total: 5,645
Research Triangle	Scheduled Air Transportation	4811	1,907
Research Triangle	Nonscheduled Air Transportation	4812	32
Research Triangle	Support Activities for Air Transport	4881	478
			Total: 2,417
OVERALL TOTAL			**18,377**

Source: Employment Security Commission of North Carolina

We now turn to gaining an understanding of the occupational structure of the aerospace employment in North Carolina. To do so, Standard Occupation Classification (SOC) data – the occupational equivalent of NAICS – were collected for the state's traditional aerospace industry. However, in an effort to minimize data suppression problems, data were collected for the same group of four-digit industries used in Table 1.5.[13] Fortunately, despite some suppression, the occupational data provide a much more complete picture than does the regional employment breakdown.

[13] See footnote 12.

Table 1.6 presents the occupational structure in aerospace product and parts manufacturing as of the second quarter of 2006. The first insight that emerges from the table is that – as one would expect – the bulk of the occupations in the industry are production-related. Related to that, one occupation that seems to be especially important is that of machinists. In fact, machinists is the single largest occupation category in the entire industry segment, comprising 12.8 percent of the 2,350 occupations listed. It is also important to note that the occupation productions in this industry tend to pay hourly wages much higher than the statewide average – $21.82 compared to $13.36. This finding also confirms the prior assertion from the employment analysis that aerospace manufacturing in North Carolina is a relatively high paying industry. Furthermore, in terms of possible expansion, Table 1.6 suggests that there is a sizable number, 11,930, of machinists employed in other disciplines in the state. Other individual occupations of note include aircraft mechanics and inspectors and testers at 7.2 and 5.1 percent of the total industry, respectively. Additionally, both occupations are paid better in aerospace manufacturing than they are in the overall North Carolina economy.

Table 1.6 – The Occupational Composition of Aerospace Product and Parts Manufacturing (3364) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Hourly Occupation Wage in Industry	Estimated Employment in State	Average Hourly Occupation Wage in State
Management Occupations	**80**	**3.4%**	**$49.49**	**179,430**	**$40.86**
General Managers	30	1.3%	$61.41	56,570	$46.94
Engineering Managers	10	0.4%	$42.44	4,650	$45.55
Business and Financial Occupations	**70**	**3.0%**	**$27.50**	**124,260**	**$25.85**
Purchasing Agents	20	0.9%	$21.27	350	$23.46
Logisticians	20	0.9%	$26.35	990	$28.80
Accountants and Auditors	10	0.4%	$27.55	21,600	$25.91
Computer and Mathematical Occupations	**20**	**0.9%**	**$31.79**	**78,020**	**$31.20**
Computer Systems Analysts	20	0.9%	$30.32	13,790	$33.45
Architecture and Engineering Occupations	**240**	**10.2%**	**$29.25**	**52,570**	**$27.29**
Aerospace Engineers	40	1.7%	$31.74	N/A	$33.09

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Hourly Occupation Wage in Industry	Estimated Employment in State	Average Hourly Occupation Wage in State
Mechanical Engineers	50	2.1%	$31.47	3,840	$31.42
Sales Occupations	**20**	**0.9%**	**$32.91**	**406,400**	**$14.58**
Sales Representatives	10	0.4%	$32.77	41,710	$23.56
Office and Administrative Support Occupations	**180**	**7.7%**	**$18.49**	**601,250**	**$13.55**
1st Line Supervisors	10	0.4%	$25.13	38,170	$20.15
Bookkeeping, Accounting, and Auditing Clerks	20	0.9%	$15.04	49,670	$13.78
Production, Planning, and Expediting Clerks	60	2.6%	$22.38	8,130	$17.70
Shipping and Receiving Clerks	20	0.9%	$15.10	24,110	$12.22
Stock Clerks	10	0.4%	$15.88	41,620	$10.26
Executive Secretaries	20	0.9%	$21.03	49,050	$16.33
General Office Clerks	30	1.3%	$12.70	67,130	$11.24
Installation, Maintenance, and Repair Occupations	**330**	**14.0%**	**$23.24**	**172,130**	**$17.34**
1st Line Supervisors	30	1.3%	$27.61	17,890	$24.40
Aircraft Mechanics	170	7.2%	$21.52	4,230	$19.30
General Maintenance and Repair Workers	30	1.3%	$21.92	45,430	$15.75
Production Occupations	**1,410**	**60.0%**	**$21.82**	**422,090**	**$13.36**
1st Line Supervisors	80	3.4%	$25.89	28,930	$22.08
Electrical Equipment Assemblers	100	4.3%	$20.82	6,080	$12.41
Team Assemblers	50	2.1%	$12.96	62,130	$11.95
Computer Controlled Machine Tool Operators	10	0.4%	$16.58	4,210	$15.10
Machinists	300	12.8%	$16.82	11,930	$15.19
Welders, Cutters, Solderers, and Brazers	10	0.4%	$12.77	9,000	$15.01
Inspectors, Testers, Sorters, Samplers, and Weighers	120	5.1%	$21.24	23,890	$13.60
TOTAL	**2,350**	**100.0 %**			

Source: Employment Security Commission of North Carolina

Tables 1.7 and 1.8 present similar results for scheduled and nonscheduled air transportation, respectively. However, the reader should note that data suppression reduces the number of occupational categories that can be shown, especially with respect to nonscheduled air transportation. Nonetheless, the available data show, perhaps not surprisingly, that the state's scheduled air transportation industry has a very heavy concentration of reservation and ticket agents.

Table 1.7 – The Occupational Composition of Scheduled Air Transportation (4811) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Management Occupations	**110**	**2.2%**	**$34.51**	**179,430**	**$40.86**
General Managers	40	0.8%	$43.21	56,570	$46.94
Transportation and Distribution Managers	20	0.4%	$22.64	2,330	$33.27
Office and Administrative Support Occupations	**4,790**	**96.4%**	**$15.95**	**601,250**	**$13.55**
Reservation and Ticket Agents	3,350	67.4%	$15.93	4,430	$15.06
Dispatchers	N/A	N/A	$15.26	4,120	$15.12
Secretaries	10	0.2%	$15.43	49,130	$12.39
Installation, Maintenance, and Repair Occupations	**50**	**1.0%**	**$19.54**	**45,430**	**$15.75**
General Repair and Maintenance Workers	50	1.0%	$19.54	45,430	$15.75
Transportation and Material Moving Occupations	**20**	**0.4%**	**$16.53**	**6,840**	**$18.33**
1st Line Supervisors	20	0.4%	$16.53	6,840	$18.33
TOTAL	**4,970**	**100.0%**			

Source: Employment Security Commission of North Carolina

Table 1.8 – The Occupational Composition of Nonscheduled Air Transportation (4812) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Management Occupations	**70**	**16.3%**	**$37.88**	**179,430**	**$40.86**

General Managers	40	9.3%	$36.71	56,570	$46.94
Office and Administrative Support Occupations	**130**	**30.2%**	**$15.27**	**601,250**	**$13.55**
1st Line Supervisors	N/A	N/A	$23.22	38,170	$20.15
Bookkeeping, Accounting, and Auditing Clerks	N/A	N/A	$10.60	49,670	$13.78
Transportation and Material Moving Occupations	**230**	**53.5%**	**$23.94**	**304,680**	**$12.75**
TOTAL	**430**	**100.0%**			

Source: Employment Security Commission of North Carolina

More interestingly, Table 1.9 shows the occupational structure in the support activities for air transport industry. As expected, the industry is dominated by installation, repair, and maintenance occupations, which according to the available data, comprise 57 percent of the entire industry. More specifically, that 57 percent consists primarily of aircraft mechanics along with avionics technicians and general maintenance and repair workers. In terms of compensation, the maintenance and repair positions pay better than the state average as a grouping, while, the largest individual occupation, aircraft mechanic, pays slightly under the state average.

Table 1.9 – The Occupational Composition of Support Activities for Air Transport (4881) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Management Occupations	**220**	**5.0%**	**$39.93**	**179,430**	**$40.86**
General Managers	100	2.3%	$46.47	56,570	$46.94
Business and Financial Occupations	**70**	**1.6%**	**N/A**	**124,260**	**$25.85**
Purchasing Agents	20	0.5%	$18.59	7,200	$23.46
Compliance Officers	10	0.2%	$20.22	2,850	$22.18
Accountants and Auditors	40	0.9%	$21.94	21,600	$25.91
Computer and Mathematical Occupations	**60**	**1.4%**	**$20.64**	**78,020**	**$31.20**
Computer Support Specialists	20	0.5%	$16.33	16,850	$20.58

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Education, Training, and Library Occupations	**10**	**0.2%**	**$21.33**	**248,850**	**$17.66**
Self Enrichment Education Teachers	10	0.2%	$21.33	3,980	$15.65
Building and Grounds Cleaning and Maintenance Occupations	**20**	**0.5%**	**$9.19**	**118,100**	**$9.61**
Sales Occupations	**50**	**1.1%**	**$24.84**	**406,400**	**$14.58**
1st Line Supervisors	10	0.2%	$28.14	11,520	$31.12
Sales Representatives	30	0.7%	$25.46	41,710	$23.56
Office and Administration Support Occupations	**520**	**11.7%**	**$13.66**	**601,250**	**$13.55**
1st Line Supervisors	50	1.1%	$19.72	38,170	$20.15
Billing and Posting Clerks	30	0.7%	$12.47	14,510	$13.34
Bookkeeping, Accounting, and Auditing Clerks	60	1.4%	$13.65	49,670	$13.78
Customer Service Representatives	80	1.8%	$10.09	59,940	$13.61
HR Assistants	10	0.2%	$14.71	4,140	$14.68
Stock Clerks and Order Fillers	70	1.6%	$12.63	41,620	$10.26
Executive Secretaries	50	1.1%	$15.75	49,050	$16.33
Other Secretaries	20	0.5%	$13.89	49,130	$12.39
General Office Clerks	30	0.7%	$10.48	67,130	$11.24
Installation, Maintenance, and Repair Occupations	**2,530**	**57.0%**	**$19.52**	**172,130**	**$17.34**
Avionics Technicians	120	2.7%	$21.86	450	$21.22
Aircraft Mechanics and Service Technicians	1,830	41.2%	$18.40	4,230	$19.30
General Maintenance and Repair Workers	120	2.7%	$19.06	45,430	$15.75
Helpers	90	2.0%	$16.13	6,530	$10.41
Transportation and Material Moving Occupations	**960**	**21.6%**	**$18.71**	**304,680**	**$12.75**
Aircraft Cargo Handling Services	20	0.5%	$18.37	60	$20.18

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
1st Line Supervisors	60	1.4%	$19.69	8,920	$21.81
Other Transportation Workers	330	7.4%	$11.66	640	$12.29
Cleaners of Vehicles	20	0.5%	$8.85	8,210	$8.90
Laborers and Material Movers	30	0.7%	$12.60	78,220	$10.43
TOTAL	**4,440**	**100.0 %**			

Source: Employment Security Commission of North Carolina

The four previous tables provide a solid understanding of the occupational composition in North Carolina's core traditional aerospace industries. However, this study wants to take that discussion one step further by comparing the occupational structure of North Carolina's industry to that of the national industry. Doing so will hopefully reveal areas where the state is fairly strong and other areas where the state is fairly weak. Accordingly, such an analysis might suggest specific areas North Carolina could target to improve or strengthen even further, if the decision were made to aggressively pursue the industry.

To that end, Tables 1.10 and 1.11 present the top 25 occupations in both aerospace manufacturing and support activities for air transport at the national level (scheduled and nonscheduled air transportation were not included due to limited data availability). The tables then display each occupation's percentage of total U.S. industry employment and compare that figure to the corresponding mark for North Carolina. With respect to aerospace manufacturing, Table 1.10 shows that the top occupation in the national industry is aerospace engineer at 9.12 percent of total employment. However, only 1.7 percent of North Carolina's aerospace manufacturing industry is comprised of aerospace engineers. Conversely, only 3.6 percent of the national industry is made up of machinists, whereas, 12.8 percent of the state's industry consists of machinists. Those facts are not by any means a condemnation of the state's industry; they just suggest that North Carolina is different than the U.S. with respect to aerospace manufacturing, i.e. the state appears to be more focused on the actual production end of the industry as opposed to the more of the research and development functions. Nonetheless, those research and development-

type operations are an important, high-paying part of the industry and may well be functions in which North Carolina would want to expand its presence in the future.

Table 1.10 – The Occupational Composition of Aerospace Product and Parts Manufacturing (3364) Compared to the Structure of the National Industry

Occupation Classification	Estimated National Employment in Industry	Percent of National Total in Industry	Percent of State Total in Industry
Aerospace Engineers	40,860	9.12%	1.7%
Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	20,510	4.58%	N/A
Aircraft Mechanics and Service Technicians	18,070	4.03%	7.2%
Machinists	16,290	3.64%	12.8%
Inspectors, Testers, Sorters, Samplers, and Weighers	14,930	3.33%	5.1%
Mechanical Engineers	13,270	2.96%	2.1%
Industrial Engineers	13,020	2.91%	N/A
Engineering Managers	10,000	2.23%	N/A
Computer Software Engineers – Applications	9,890	2.21%	N/A
Management Analysts	8,750	1.95%	N/A
Purchasing Agents	8,600	1.92%	0.9%
1st Line Supervisors - Production	8,600	1.92%	3.4%
Business Operations Specialists	8,190	1.83%	N/A
Other Engineers	7,820	1.75%	N/A
Production, Planning, and Expediting Clerks	7,300	1.63%	2.6%
Executive Secretaries	7,050	1.57%	0.9%
Team Assemblers	6,820	1.52%	2.1%
Industrial Engineering Technicians	6,350	1.42%	N/A
Aerospace Engineering Technicians	5,280	1.18%	N/A
Computer Software Engineers – Systems Software	5,180	1.16%	N/A
Industrial Production Managers	5,060	1.13%	N/A
Computer-Controlled Machine Tool Operators	5,060	1.13%	0.4%
General Maintenance and Repair Workers	4,750	1.06%	1.3%
Avionics Technicians	4,720	1.05%	N/A
Computer Systems Analysts	4,590	1.02%	0.9%
TOTAL	**260,960**	**58.25%**	**41.40%**

Source: Bureau of Labor Statistics

With respect to support activities for air transport, Table 1.11 shows that aircraft mechanic is the top occupation in both the national and state industry. However, the percentage level in North Carolina is more than double that of the national industry – 41.2 percent compared to 18.1 percent. This seems to imply as has been suggested consistently throughout this analysis that North Carolina has strong maintenance and repair presence, at least in relative terms.

Table 1.11 – The Occupational Composition of Support Activities for Air Transport (4881) Compared to the Structure of the National Industry

Occupation Classification	Estimated National Employment in Industry	Percent of National Total in Industry	Percent of State Total in Industry
Aircraft Mechanics and Service Technicians	26,060	18.09%	41.2%
Freight, Stock, and Material Movers	11,180	7.76%	0.7%
Other Transportation Workers	7,960	5.52%	7.4%
Baggage Porters	6,110	4.24%	N/A
Cargo and Freight Agents	5,430	3.77%	0.5%
Customer Service Representatives	4,280	2.97%	1.8%
Reservation and Ticket Agents	3,870	2.69%	N/A
Avionics Technicians	3,470	2.41%	2.7%
1st Line Supervisors – Maintenance and Repair	3,180	2.21%	N/A
Other Transportation Attendants	3,030	2.10%	N/A
Commercial Pilots	3,010	2.09%	N/A
General Maintenance and Repair Workers	2,750	1.91%	2.7%
Cleaners of Vehicles	2,700	1.87%	0.5%
General Managers	2,250	1.56%	2.3%
General Office Clerks	2,180	1.51%	0.7%
Security Guards	2,150	1.49%	N/A
Janitors	2,010	1.39%	N/A
1st Line Supervisors – Office and Administrative	1,690	1.17%	1.1%
Bookkeeping, Accounting, and Auditing Clerks	1,550	1.08%	1.4%
Transportation Inspectors	1,510	1.05%	N/A
Machinery Maintenance Workers	1,460	1.01%	N/A
Maintenance and Repair Helpers	1,440	1.00%	2.0%
Service Station Attendants	1,410	0.98%	N/A
Executive Secretaries	1,360	0.94%	1.1%
Truck Drivers	1,220	0.85%	N/A
TOTAL	**103,260**	**71.66%**	**66.1%**

Source: Bureau of Labor Statistics

In summary, the analysis in chapter one suggests four key findings. First, the overall numbers presented seem to suggest that the North Carolina Space Initiative's description of the state's *overall* traditional aerospace presence as "modest" is a fairly reasonable assessment. Second, chapter one also reveals that traditional aerospace is a relatively high-paying industry. In fact, traditional aerospace was found to consistently pay better than the state and even sometimes the nation for comparable work. Third, albeit a somewhat preliminary finding, traditional aerospace was found to have a significant presence in most of the regions of North Carolina. And fourth, despite a "modest" *overall* presence, the analysis in chapter identifies two specific segments of the state's industry –

aerospace manufacturing (specifically engine and engine part manufacturing) and aircraft maintenance and repair – that seem to be areas of existing strength and perhaps future potential. Chapter two will attempt to add additional contextual information and qualitative data before we make more definitive conclusions.

CHAPTER II: A RESOURCE CATALOG

Chapter one provides a detailed quantitative snapshot of the state's traditional aerospace presence. However, numbers alone cannot tell the whole story, especially when it comes to issues like understanding whether or not the state is well positioned to expand its presence whether it be in traditional aerospace or the commercial space industry. Additionally, pure quantitative analysis is not particularly well suited to reveal any insights as to why certain industry concentrations do or do not exist. Accordingly, chapter two will employ a more qualitative approach – relying on interviews, articles, reports, and some data – in an attempt to paint a more complete picture of North Carolina's aero/space economy and its potential in the future. To do so, the following chapter will evaluate the state on the following six criteria: corporate presence, military presence, educational capacity, institutional presence, infrastructure availability, and innovation. In the end, chapter two will hopefully supply some much needed context to the story told in the previous chapter and provide an initial assessment of the state's position with respect to aero/space.

Corporate Presence

Employment levels are useful, but it is also important to gain an understanding of the firms that employ them. Accordingly, this section is intended to highlight a number of the key aero/space companies currently operating in the state. The list is by no means intended to be exhaustive; instead its focus is to inventory those firms that serve as the foundation of the State's aero/space presence, especially those which are headquartered in North Carolina.

B/E Aerospace – B/E Aerospace is the leading manufacturer of cabin interior products for the world's airlines, aircraft manufacturers, and business jet owners. B/E's corporate headquarters is in Wellington, Florida; however, their Commercial Aircraft Division is based in Winston-Salem. The Commercial Aircraft Division's specialization is seat manufacturing. In fact, the company is reportedly the world's largest producer of aircraft seating with more manufacturing capacity for those products than all other competing companies combined. The company has received over a billion dollars worth of orders

from international carriers in the past two years alone (Craver 2006a). The Winston-Salem facility which focuses primarily on design and engineering is located near the Smith-Reynolds Airport and employs nearly 600 workers. However, a recent 165 million dollar contract to produce seating and other cabin products for United Airlines has prompted the announcement of an expansion at the Winston-Salem location which translates into another 50 or so jobs and new production facilities (Craver 2006b).

Company website: http://www.beaerospace.com/

Bridgestone Aircraft Tire – Bridgestone Aircraft Tire is a division of the Bridgestone Corporation, the world's largest tire and rubber company. The company announced in May of 2006 that it was relocating its U.S. production facility to Mayodan in Rockingham County. The move will create 95 new jobs with anticipated average wage levels 25 percent higher than the overall county average. The new 160,000 square foot facility will manufacture tires for both the Boeing 787 Dreamliner and the Airbus A380 (Bridgestone 2006).

Company website: http://ap.bridgestone.co.jp/index.html

Curtiss-Wright Corporation – Curtiss-Wright Corporation's Motion Control segment, which is headquartered in Charlotte, is a global leader in the design, manufacture, service, and integration of motion control components and subsystems for defense, aerospace, naval and other industrial applications. The Motion Control division is one the leading subsystem suppliers in the U.S. as it maintains long-term business relationships with customers like Boeing, Lockheed Martin, Northrop Grumman, as well as, all the branches of the military. Their subsystem offerings include commercial and military aircraft secondary flight controls, utility actuation, ammunition handling, airborne fire protection systems, and rotor ice detection. In addition to the headquarters facility, the division also operates production facilities in Gastonia and Shelby plus recently expanded engineering and test facilities also located in Gastonia. In total, the Motion Controls division has 2,200 employees nationwide, 320 of which are located in the Charlotte region (Hartnett 2005).

Company website: http://www.curtisswright.com/default.asp

Geomagic, Inc. – Geomagic, Inc. is a software and services company headquartered in the Research Triangle Park. Geomagic is emerging as a leader in digital shape sampling and processing software which allow companies to develop highly detailed 3-D models of objects in order to detect potential imperfections. Their software is of particular use in the aerospace industry where the quality of parts is paramount. In fact, Geomagic's products are used by NASA to test sensitive components and also by companies to help reconstruct parts no longer in production.

Company website: http://www.geomagic.com/en/

General Dynamics Armament and Technical Products (GDATP) – General Dynamics' Armament and Technical Products division, which is headquartered in Charlotte, is a proven systems integrator of defense products for all branches of the U.S. Department of Defense and the ministries of defense of over 30 other foreign nations. GDATP specializes in the production of gun, weapon, and detection systems, as well as, the manufacture of a wide range of advanced material products which include internal and external aircraft structural components. GDATP operates eight production facilities throughout the U.S., only one of which is located in North Carolina, a chemical and biological detection system facility in Charlotte.

Company website: http://www.gdatp.com/

General Electric Aviation – GE Aviation, a division of General Electric, is the world's leading producer of large and small jet engines for commercial and military aircraft. In addition to being the current global leader, GE also has a quite impressive history in the industry including the development of some the military's first aircraft engines during World War I, as well as, the production of the country's first jet engine in the 1940s. Today, the company is headquartered in Cincinnati, Ohio, but does have an engine assembly facility in Durham.

Company website: http://www.geae.com/

Goodrich Corporation – Goodrich Corporation, headquartered in Charlotte, is a leading global supplier of aerospace systems and services. Goodrich, which boasts "if there's an aircraft in the sky, were on it", manufacture a wide array of aerospace and defense products including ice detection systems, laser warning systems, engine control systems, rotor brake systems, fuel pump systems, temperature and pressure sensors, windshield wiper systems, engine actuation systems, among many, many others (Goodrich 2006). Goodrich operates more than 120 facilities worldwide in 20 countries with annual revenues of over 4.7 billion dollars. The company moved to Charlotte in 1998 and currently employs about 280 people at its headquarters facility and another 460 at its customer service center in Monroe. And while the name, customer service center, tends to evoke images of a giant call center, Molly Friddle of Goodrich's Corporate Communications, notes that the center is actually a large industrial facility which specializes in refurbishing old Goodrich parts and components (M. Friddle, personal communication, February 8, 2007).

Company website: http://www.goodrich.com/Main

Honda Aircraft Company – Honda Aircraft Company, the aircraft division of the world renowned automaker, has been conducting all of its prototype assembly and testing at the Piedmont Triad International Airport since 2001. Specifically, the company has been developing the HondaJet, its entry into the new very light jet (VLJ) market. However, until recently it was unknown whether or not Honda would actually establish its permanent headquarters and production facilities in the Triad. But, in February of this year, Honda Aircraft announced that they would make Greensboro the home of its corporate and manufacturing operations. The announcement translates into a reported 60 million dollars worth of investment and more than 300 new jobs for the city – positions which include engineers, researchers, sales and marketing staff, production workers, and the company's management team. Phase one of the project is scheduled to be complete by the end of this year and the first HondaJet is expected to roll out of the facility by 2010. Their VLJs which will reportedly retail for 3.65 million dollars are expected to set themselves off from the competition by offering a class-topping cruise speed of 420 knots and 30 to 35 percent better fuel efficiency than other similar jets. According to company

officials, the company has already received more than 100 orders for the HondaJet (HondaJet 2007).

Company website: http://hondajet.honda.com/

Why Greensboro? – The HondaJet announcement is a huge development for Greensboro, but in terms of future aerospace development in the Triad and elsewhere in the state it is especially important to understand what factors led the company to choose Greensboro. Andrea Miller, Manager of Cluster Development for the Greensboro Economic Development Alliance, says there were several factors that played a role. First and foremost, she says that Honda was drawn to the airport facility itself. Miller says it was important for the company to be at an airport that was big enough to handle their take-off and landing needs, but that could also offer them enough room to grow without running into too much other traffic. Second, Miller notes that Honda was impressed by the educational offerings available in the area. Specifically, she says the Greensboro area is home to the T.H. Davis Aviation School – part of Guilford Technical Community College – which offers students training in aviation systems and airport management. Additionally, Guilford Tech offers students a transfer program with Embry-Riddle Aeronautical University in Daytona, Florida. Furthermore, Miller notes that North Carolina A&T University in Greensboro has a composite materials center that was of interest to the company (A. Miller, personal communication, February 8, 2007)..

Background on Very Light Jets – Equally as important as understanding why Honda chose Greensboro is understanding something about the product they look to produce there. Accordingly, this section provides some quick general background on very light jets. Very lights jets or VLJs, as they are commonly referred to, are aircraft typically designed to carry between three to seven passengers in addition to a single pilot and crew member. They are lighter than the traditional business jet, usually targeting a take-off weight of less than 10,000 pounds. VLJs also tend to be considerably cheaper than the standard business jet, retailing in a range from just over one million dollars up to nearly four million. VLJs are ideal for point-to-point travel of trips up to around 1,000 miles. Additionally, VLJs are capable of landing on runways as short as 2,500 feet which

greatly increases their number of potential destinations. Their main audience is expected to be corporations, high-end private owners, and air taxi companies intending to offer customizable point-to-point charter service. However, despite their growing popularity, VLJs have their skeptics. Some industry experts dismiss the hype around VLJs and cite concerns about increased traffic in the skies and an overburdened air traffic control system. Nonetheless, proponents casually dismiss those claims as they emphasize that VLJs are intended to take advantage of the country's network of smaller airports where they are no threat to clog up busy international hubs. Regardless of the merits of that debate, companies all across the country are gearing up to start delivering fleets of the new jets. There are five major players in the VLJ industry: Cessna, Eclipse, Adam Aircraft, Embraer, and Greensboro's own HondaJet. The industry pioneer, Eclipse Aviation, is leading the production charge. Eclipse reportedly already has orders for 2,500 of its Eclipse 500 jet which it is selling for an industry low 1.52 million dollars – DayJet, an air taxi company operating out of Delray Beach, Florida, has already ordered 239 of the Eclipse VLJs as they attempt to get their point-to-point operations underway throughout the southeast. Industry forecast predict that around 5,000 VLJs will be demanded by 2010 (Hirschman 2006).

Smiths Aerospace – Smiths Aerospace is a "transatlantic aerospace systems and equipment company", with over $2 billion sales and more than 11,000 employees worldwide. Smiths Aerospace, headquartered in London, currently operates two facilities in North Carolina, one in West Jefferson and one in Asheville. Both plants specialize in machining precision components for aircraft engines, which Smiths supplies to GE Aircraft Engines, Pratt and Whitney, and Rolls-Royce. Both plants provide well-paid employment to their respective areas – the average weekly wage in West Jefferson is said to be nearly 100 dollars more than the average wage for the county as a whole – however, the future of those positions seems to be somewhat up in the air. In January of this year, Smiths Group of London announced the pending sale of its aerospace division to GE for 4.8 billion dollars in cash (Mitchell 2007).

Nonetheless, the outlook for those two facilities received a recent vote of confidence as Smiths announced in March of 2007 that it would further expand its presence in North

Carolina by opening a new 90,000 square foot production facility adjacent to its existing Asheville plant. The new facility is expected to provide the area with around 200 additional high-tech manufacturing jobs over the next five years. Specifically, the new Asheville plant will look to hire skilled machinists to produce complex parts for jet engines – positions that are expected to pay wages well above the average for the region. This recent expansion does not necessarily secure the future for Smiths in North Carolina as it was planned well before the pending deal with GE. However, company spokesman, Dale Collins, says Smiths has been in the area since 1947 and that they "have no plans to leave" (Neal 2007).

Company website: http://www.smiths-aerospace.com/

TIMCO – TIMCO (Triad International Maintenance Company) is the largest independent, third-party maintenance, repair, and overhaul (MRO) provider in the country. The company, which employs over 4,000 employees worldwide, is headquartered in Greensboro where they operate a 600,000 MRO facility at the Piedmont Triad International Airport complete with four state-of-the-art hangars. Also on site is a composites repair shop, a training facility, as well as, a 63,000 square foot machining center. In addition to their extensive MRO operations, TIMCO also produces aircraft replacement parts, overhauls aircraft interiors, and offers various engineering support services.

Company website: http://www.timco.aero/index.php

Military Presence

In terms of aero/space activity, particularly with respect to traditional aerospace, private industry is not the only major player in North Carolina. The military is also a key aero/space employer, producer, and consumer. Accordingly, this section is intended to provide a full inventory of the state's military assets which have an aviation presence.

Seymour Johnson Air Force Base – Seymour Johnson Air Force Base located in Goldsboro is home to the Air Force's 4th Fighter Wing and the 916th Refueling Wing. The

3,300 acre base which opened in 1942 has 6,400 military personnel stationed there, in addition to around 600 civilian employees. 2,300 of those military and civilian personnel are assigned to the 4th Fighter Wing's Maintenance Group which is responsible for the maintenance and repair of the base's 96 F-15E Strike Eagles. The 4th Fighter Wing also consists of a mission support group, an operations group, and a medical group.

Base website: http://www.seymourjohnson.af.mil/units/

Marine Corps Base Camp Lejeune – Camp Lejeune a 156,000 acre base located in Onslow County is home to 43,000 marines and around 5,000 civilian employees. Camp Lejeune is the home base to the II Marine Expeditionary Force, the 2nd Marine Division, and the 2nd Marine Logistics Group among others. However, the base is not home to any direct aviation presence. The 2nd Marine Air Wing which is affiliated with Camp Lejeune is actually stationed at the nearby Cherry Point Marine Corps Air Station.

Base website: http://www.lejeune.usmc.mil/mcb/index.asp

New River Marine Corps Air Station – The New River Air Station is a 2,600 acre facility which sits adjacent to Camp Lejeune in Onslow County. New River which was established in 1941 is considered to be the principal operating location for marine helicopters on the east coast. Specifically, the station is home to Marine Aircraft Groups 26 and 29 which together include approximately 200 aircraft.

Base website: http://www.newriver.usmc.mil/index.htm

Elizabeth City Coast Guard Air Station – The Elizabeth City Air Station located on the Albemarle Sound is the headquarters for all Coast Guard aviation operations. The station which has been is existence since 1940 is home to 500 active-duty personnel and also employs another 450 civilians. Specifically, the air station operates a fleet of HH-60 Jayhawk and HC-130 Hercules helicopters. More importantly, however, the Elizabeth City complex is also home the Aircraft Repair and Supply Center which is in charge of the overhaul and repair of all Coast Guard aircraft, as well as, managing the procurement,

storage, and issuance of all Coast Guard aircraft parts and supplies. Furthermore, the air station also houses the Coast Guard's Aviation Technical Training Center.

Base website: http://www.uscg.mil/d5/airstation/ecity/

Pope Air Force Base / Fort Bragg – Currently, Pope Air Force Base's 2,194 acres house the 43rd Airlift Wing, the 23rd Fighter Group, and the 18th Air Support Operations Group. The base is also home to 4,700 active-duty military personnel and another 500 civilian employees. The base's primary mission includes the worldwide transportation of military personnel, equipment, and supplies, as well as, providing support to the renowned 82nd Airborne Division and other units which are housed at the adjacent Fort Bragg. However, the latest round of base realignment and closure (BRAC) announcements calls for Pope to essentially be annexed by its massive neighbor within the next four years in order to make room for the relocation of the Army's U.S. Force Command Headquarters (FORSCOM) and U.S. Army Reserve Command from Forts McPherson and Gillen to Fort Bragg. In response, Pope's 43rd Airlift Wing will be distributed to Little Rock Air Force Base in Arkansas and its 23rd Fighter Group will be moved to Moody Air Force Base in Georgia. Accordingly, the Fort Bragg facility will be stripped of much of its aviation presence; however, the Fayetteville base – already one of the largest military facilities in the world – will receive approximately 20,000 more military personnel, family members, and civilian employees. But even more importantly, the state's traditional aerospace and defense industries potentially stand to benefit greatly from the presence of FORSCOM which is responsible for all of the Army's procurement decisions. In addition to bolstering the Fayetteville region itself, the relocation of FORSCOM could significantly improve the North Carolina's current lack of defense contract business and potentially attract valuable supply companies to the state.

Base websites: http://public.pope.amc.af.mil/
http://www.bragg.army.mil/

Cherry Point Marine Corps Air Station – The relocation of FORSCOM to North Carolina will likely strengthen Fort Bragg's status as the state's most valuable military asset, but in terms of traditional aerospace, specifically, the state's true crown jewel is without

question the Cherry Point Air Station. The 13,000 acre facility located in Havelock is home to the 2nd Marine Aircraft Wing (MAW) which includes three AV-8B Harrier squadrons, four EA-6B Prowler squadrons, and one KC-130 Hercules refueling squadron. There are 7,486 marine stationed at Cherry Point plus another 5,700 civilian employees. Studies have estimated that the facility pumps around 610 million direct dollars into the local economy each year in the form of salaries and local supply and capital expenditures.

In addition to the 2nd MAW, Cherry Point also houses the Navy's Fleet Readiness Center (FRC) East. The FRC employs more than more than 4,000 civilian and military personnel making it the single largest industrial employer in eastern North Carolina. FRC East began in 1943 as the Assembly and Repair Department for Cherry Point. Since then, it has developed into a state-of-the art repair facility for Marine and Navy Aircraft. In fact, FRC East is one of only six such facilities in the entire country. Specifically, FRC East specializes in the maintenance and repair of airframe, engines, and more than 16,000 other avionics components. Furthermore, the center is listed as the only location in the continental U.S. that can repair certain types of engines, namely, specific rotary wing engines and turbofan vectored thrust engines. Accordingly, FRC East's lengthy client list includes 202 different Navy and Marine Corps operations, five Air Force operations, three Army operations, two other federal agencies, and 24 foreign countries.

The FRC facility, which spans 150 acres and over 100 buildings, also houses The Naval Engine Airfoil Center which focuses on the repair of aircraft turbines and replacement blades and vanes. Additionally, the FRC also has a research and engineering group whose staff of engineers helps ensure work quality and develop testing and troubleshooting procedures for the center's various operations. Their engineering staff is also available to be dispatched anywhere in world in order to provide technical support to assorted military endeavors.

Base websites: http://www.cherrypoint.usmc.mil/
http://www.nadepcp.navy.mil/default.htm

Department of Defense Procurement – North Carolina touts itself as one of the most military friendly states in the country. Yet that hospitality has not yet translated into

much Department of Defense (DoD) contract activity. As of 2005, according to the Department of Defense's Statistical Information Analysis Division, North Carolina was home to 8.9 percent of all military personnel – the fourth largest presence in the U.S. behind only California with 13.3 percent, Virginia with 11.0 percent, and Texas at 9.6 percent. However, in terms of military spending North Carolina is not home to a corresponding level of procurement activity. In fiscal year (FY) 2005 the state only received 1.24 percent – roughly 2.9 billion dollars – of total defense procurement contracts awarded in the U.S. On a somewhat more positive note, the military spending that does occur in North Carolina is seemingly beneficial to almost the entire state. In FY 2005, firms in 97 out of North Carolina's 100 counties were awarded defense contracts. The top five recipients were Cumberland County, the home of Fort Bragg, with 946 million, Onslow County with 390 million, Craven County with 199 million, Wake County with 197 million, and Mecklenburg County with 148 million. However, this information should be tempered with the caveat that "awarded to a county" simply means that a contract was given to company with a presence there, not necessarily that the production or service was actually performed in that locality.

In terms of aero/space-related contracts specifically, unfortunately, the story is more of the same. As Table 2.1 reveals, in FY 2005 North Carolina received less than one percent of the total contracts awarded in each of the four major aero/space supply categories. Furthermore, Table 2.2 shows the dollar amount in each of the four major categories as a percentage of the total contracts awarded at both the state and national-level also paints a rather gloomy picture. According to the data, aero/space contracts represent nearly a quarter of all DoD procurement spending, however, aero/space contracts only comprise slightly less than seven percent of total military spending in the state. The state does basically hold its own in terms of other aircraft equipment, but lags significantly in airframes and is almost nonexistent in missile and space systems.

Table 2.1 – Major Aero/space-Related Procurement Program Spending in North Carolina as a Percentage of Total Program Spending

Major Procurement Program	North Carolina Contract Dollars	Percentage of Total Program Dollars
Aircraft Engines and Spares	$17,440,942	0.26 %
Airframes and Spares	$102,648,128	0.37 %
Missile and Space Systems	$2,860,086	0.02 %
Other Aircraft Equipment	$74,967,845	0.91 %
TOTAL CONTRACT DOLLARS (All Programs)	**$2,948,582,828**	**1.24 %**

Source: The Department of Defense's Statistical Information Analysis Division

Table 2.2 – Major Aero/space-Related Procurement Program Spending in North Carolina as a Percentage of Total DoD Spending in the State

Major Procurement Program	As a Percentage of Total North Carolina Contract Dollars	As a Percentage of Total DoD Contract Dollars
Aircraft Engines and Spares	0.59 %	2.85 %
Airframes and Spares	3.48 %	11.59 %
Missile and Space Systems	0.10 %	7.03 %
Other Aircraft Equipment	2.54 %	3.48 %
TOTAL	**6.71 %**	**24.95 %**

Source: The Department of Defense's Statistical Information Analysis Division

It is important to note, however, that the previous two tables only account for supply contracts and not for spending on services such aircraft maintenance and repair. An equivalent spending breakdown by state was not readily available to gauge North Carolina's participation; nonetheless, the data presented in Table 2.3 do give some idea of the magnitude of DoD spending in those areas, albeit at a national level. Accordingly, Table 2.3 suggests that even though the nine highlighted service categories only make up a little over one percent of total DoD spending, there is still nearly three billion dollars worth of contracts being devoted to those services with more than 85 percent of that money going to maintenance and repair.

Table 2.3 – Total Aerospace-Related Service Contract Spending as a Percentage of Total DoD Spending /

Service Classification	Total DoD Contract Dollars in Category	Percent of Total DoD Spending
J015 Maintenance, Repair, and Rebuilding of Equipment: Aircraft and Airframe Structural Components	$1,550,434,871	0.57 %

Service Classification	Total DoD Contract Dollars in Category	Percent of Total DoD Spending
J016 Maintenance, Repair, and Rebuilding of Equipment: Aircraft Components and Accessories	$900,110,876	0.33 %
J017 Maintenance, Repair, and Rebuilding of Equipment: Aircraft Launching, Landing, and Ground Handling Equipment	$31,687,707	0.01 %
K015 Modification of Equipment: Aircraft and Airframe Structural Components	$173,787,717	0.06 %
K016 Modification of Equipment: Aircraft Components and Accessories	$235,392,586	0.08 %
K017 Modification of Equipment: Aircraft Launching, Landing, and Ground Handling Equipment	$655,262	0.0002 %
N015 Installation of Equipment: Aircraft and Airframe Structural Components	$22,826,567	0.008 %
N016 Installation of Equipment: Aircraft Components and Accessories	$1,012,725	0.0004 %
OVERALL TOTAL	**$2,915,908,311**	**1.08 %**

Source: The Department of Defense's Statistical Information Analysis Division

Educational Assets

An especially key component of the state's capacity to expand its aero/space presence is its ability to produce the required workforce. Accordingly, this section is intended to provide an inventory of the aero/space-related curricula offered at the state's community colleges and universities. In addition, this section also provides an in-depth look at several of the state's most important aero/space-related educational programs.

Colleges and Universities – North Carolina is home to 57 four-year colleges and universities. Included in that total are the 16 campuses of the state's public university system along with 41 other private colleges and universities. This analysis focuses on the state's college and universities because those institutions play a vital role in producing key segments of the workforce needed to grow and maintain a successful aero/space industry. Specifically, this analysis is interested in examining the number of engineering and other technology-related programs available at the state's colleges and universities. Additionally, it is also quite important to understand whether the programs that do exist are actually producing meaningful numbers of graduates.

Accordingly, Table 2.4 lists all the program offerings in the state, the degrees available within in each program, as well as, the number of students that graduated from each program in the 2005-2006 school year. The program information for both the public and

private institutions was furnished via the Academic Program Inventory maintained and published by the UNC System's Office of General Administration. The information detailing the number of actual degrees conferred was obtained from the annual, institutional fact books published by each individual college and university. Finally, the collection of specific disciplines to include in the analysis was determined using the list of top national aero/space occupations as discussed in chapter one, as well as, the results of the numerous interviews included throughout this paper.

In general, the findings suggest that overwhelming majority of engineering and technical graduates produced in North Carolina are from the publicly-supported institutions. In fact, Duke University was the only private institution found to have any relevant aero/space-related offerings. That being said, the public universities do seem to produce a fair number of engineers and other technicians though they are concentrated only at two institutions, N.C. State and North Carolina A&T. In fact, using the data in Table 2.4, the two schools produce around 57 percent of the bachelor's, 62 percent of the master's, 79 percent of the doctorates, and 59 percent of the total aero/space related degrees in the state.

Another key dimension of Table 2.4 is the number of degrees awarded within specific disciplines. Clearly, even though there is an important need for them in the aero/space industry, most graduates in the fields of computer, industrial, and mechanical engineering will not find employment in aero/space. There is one specific discipline, however, aerospace engineering, whose graduates have a fairly high probability of being employed in either traditional aerospace or commercial space. But, in terms of aerospace engineer production, the state does not appear to receive very high marks at least with respect to quantity. N.C. State is the only institution that offers a program in aerospace, yet, in their last full school year the program only produced 45 total graduates. By comparison, during the same period, Georgia Tech – the state of Georgia's leading engineering institution to be discussed in the next chapter – produced 261 aerospace engineers – 136 bachelor's degrees, 100 master's degrees, and 25 PhD's (Georgia Tech 2006). These results should not be all that surprising since the occupation data discussed in the

preceding chapter showed that the state is estimated to employ only 40 such engineers in its aero/space industry.

Table 2.4 – Aero/space-Related Program Offerings and Degrees Conferred by North Carolina Colleges and Universities

Degree Program	College or University	Degrees Offered (B=bachelor's, M=master's, D=doctorate)	Degrees Conferred (2005-2006, unless otherwise noted)
Aerospace Engineering	N.C. State*	B, M, and D	32, 10, 3
	TOTAL		**32, 10, 3**
Computer Engineering (General)	North Carolina A&T (includes computer and electrical)	B	31
	N.C. State	B, M, and D	133, 37, 12
	UNC – Charlotte	B	21
	TOTAL		**185, 37, 12**
Industrial Engineering	North Carolina A&T*	B, M, and D	29, 11, 2
	N.C. State*	B, M, and D	55, 27, 6
	TOTAL		**84, 38, 8**
Materials Engineering	N.C. State*	B, M, and D	31, 14, 14
	TOTAL		**31, 14, 14**
Mechanical Engineering	North Carolina A&T* (includes mechanical and chemical)	B, M, and D	52, 18, 4
	N.C. State*	B, M, and D	145, 32, 9
	UNC – Charlotte*	B, M, and D	83, 26, 6
	TOTAL		**280, 76, 19**
Mechanical Engineering and Materials Science	Duke*	B, M, and D	41, 9, 7
	TOTAL		**41, 9, 7**
Computer Engineering Technology	East Carolina	B	30
	TOTAL		**30**
General Engineering Technology	Western Carolina*	B	12 (04-05)
	TOTAL		**12**
Engineering and Industrial Management	UNC – Charlotte	M	15
	TOTAL		**15**
Industrial Technology	East Carolina	B and M	94, 47
	Elizabeth City State	B	8 (02-03)
	North Carolina A&T	B and M	8, 22
	Western Carolina	B and M	12, 7 (04-05)
	TOTAL		**122, 76**
Manufacturing Technology	East Carolina	B	8

Degree Program	College or University	Degrees Offered (B=bachelor's, M=master's, D=doctorate)	Degrees Conferred (2005-2006, unless otherwise noted)
	Western Carolina	B	13 (04-05)
	TOTAL		**21**
Mechanical Technology	UNC – Charlotte	B	76
	TOTAL		**76**
Aeronautics, Aviation, and Aerospace Technology	Elizabeth City State	B	Not Available
	TOTAL		**Not Available**
	OVERALL TOTAL		**914, 275, 63**

Source: The University of North Carolina's Office of General Administration
*****Signifies that the program has been accredited by the Accreditation Board for Engineering and Technology (ABET), the recognized accreditor for college and university programs in applied science, computing, engineering, and technology.
http://www.abet.org/

Community Colleges – One of the attractions of the aero/space industry is the fact that it has the potential to provide well-paying jobs to workers without four-year, bachelor degrees. Accordingly, it is important for this analysis to examine the state's community college system to determine if key aero/space-related programs are being offered and if so, how many graduates are being produced.

Table 2.5 lists all the relevant aero/space programs offered throughout the state's expansive network of 58 community colleges, as well as, the number of degrees conferred during the 2005-2006 school year. As was the case with the four-year analysis above, the specific disciplines included in the chart were selected by examining the national occupation data for the industry, in addition to input obtained from various interviews. The specific program and degree data included in the chart were obtained from reports published by the North Carolina Community College System in 2006.

Based on the national occupation data and information from interviews, it is clear that the heart of the workforce, particularly in traditional aerospace, is comprised of technicians and other trade specialists, i.e. the types of workers who do not necessarily need a four-year degree. Specifically, maintenance and repair technicians and especially skilled machinists seem to be occupations that are of particular importance to North Carolina's aero/space industry. The data reveal that the state's community college system does offer

programs in both of those key areas. However, upon closer inspection two issues immediately emerge. First, even though are 37 colleges offering machining technology, in aggregate they only produced 63 graduates in what has been frequently identified as a key need for the future labor force of the state's aero/space industry. Second, in terms of repair and maintenance, the state has only three aviation systems technology programs which produced a total of just 18 graduates during the most recent school year.

Table 2.5 – Aero/space-Related Program Offerings and Degrees Conferred by North Carolina Community Colleges

Degree Program	Community College	Degrees Offered (A=associate's)	Degrees Conferred (2005-2006, unless otherwise noted)
Computer Engineering Technology (A40160)	Asheville-Buncombe	A	7
	Cape Fear	A	21
	Catawba Valley	A	3
	Central Carolina	A	4
	Central Piedmont	A	5
	College of the Albemarle	A	3
	Craven	A	0
	Davidson	A	0
	Forsyth	A	6
	Gaston	A	1
	Isothermal	A	3
	Lenoir	A	8
	Mayland	A	1
	Nash	A	5
	Richmond	A	4
	Sandhills	A	1
	Southwestern	A	1
	Stanly	A	7
	Surry	A	4
	Wake	A	6
	Western Piedmont	A	1
	Wilkes	A	5
	TOTAL		**96**
Industrial Engineering Technology (A40240)	Catawba Valley	A	3
	Gaston	A	6
	Lenoir	A	3
	Rowan-Cabarrus	A	4
	Wake	A	1
	TOTAL		**17**
Manufacturing Engineering Technology (A40300)	Central Piedmont*	A	2
	Forsyth	A	0
	Haywood	A	3

Degree Program	Community College	Degrees Offered (A=associate's)	Degrees Conferred (2005-2006, unless otherwise noted)
	Mitchell	A	3
	Pitt	A	0
	Rockingham	A	0
	Stanly	A	0
	Wake*	A	1
	TOTAL		**9**
Mechanical Engineering Technology (A40320)	Asheville-Buncombe	A	3
	Beaufort	A	1
	Blue Ridge	A	1
	Caldwell	A	0
	Cape Fear	A	7
	Catawba Valley	A	3
	Central Carolina	A	1
	Central Piedmont	A	5
	Craven	A	2
	Forsyth	A	0
	Gaston	A	3
	Guilford	A	7
	Haywood	A	0
	Isothermal	A	3
	Lenoir	A	0
	Mitchell	A	0
	Pitt	A	2
	Richmond	A	1
	Rockingham	A	0
	South Piedmont	A	0
	Stanly	A	0
	Wake	A	9
	Wayne	A	0
	Western Piedmont	A	3
	Wilson	A	0
	TOTAL		**51**
Aviation Management and Career Pilot Technology (A60180)	Caldwell	A	0
	Guilford	A	6
	Lenoir	A	6
	TOTAL		**12**
Aviation Systems Technology (A60200)	Craven#	A	11
	Guilford#	A	7
	Wayne#	A	0
	TOTAL		**18**
Computer Aided Drafting (A50150)	Asheville-Buncombe	A	1
	TOTAL		**1**
Industrial Systems Technology (A50240)	Alamance	A	1
	Asheville-Buncombe	A	0
	Beaufort	A	2

Degree Program	Community College	Degrees Offered (A=associate's)	Degrees Conferred (2005-2006, unless otherwise noted)
	Bladen	A	2
	Blue Ridge	A	2
	Brunswick	A	0
	Caldwell	A	0
	Cape Fear	A	0
	Catawba Valley	A	1
	Central Carolina	A	1
	Cleveland	A	0
	Craven	A	2
	Davidson	A	0
	Durham	A	0
	Edgecombe	A	0
	Forsyth	A	0
	Gaston	A	0
	Guilford	A	2
	Halifax	A	3
	Haywood	A	1
	Isothermal	A	3
	Johnston	A	0
	Martin	A	2
	Mayland	A	0
	McDowell	A	0
	Montgomery	A	0
	Nash	A	0
	Piedmont	A	13
	Pitt	A	6
	Randolph	A	1
	Richmond	A	2
	Roanoke Chowan	A	0
	Robeson	A	2
	Rockingham	A	0
	Rowan	A	0
	Sampson	A	0
	Sandhills	A	0
	South Piedmont	A	0
	Southeastern	A	1
	Stanly	A	0
	Surry	A	1
	Vance-Granville	A	0
	Wake	A	9
	Wayne	A	2
	Western Piedmont	A	1
	Wilkes	A	3
	Wilson	A	0
	TOTAL		**63**
Industrial Management Technology (A50260)	Alamance	A	0
	Caldwell	A	0
	Cleveland	A	1
	Lenoir	A	0
	Pitt	A	2

Degree Program	Community College	Degrees Offered (A=associate's)	Degrees Conferred (2005-2006, unless otherwise noted)
	South Piedmont	A	0
	Stanly	A	0
	TOTAL		**3**
Machining Technology (A50300)	Alamance	A	5
	Asheville-Buncombe	A	3
	Beaufort	A	0
	Blue Ridge	A	1
	Caldwell	A	0
	Cape Fear	A	3
	Catawba Valley	A	0
	Central Carolina	A	0
	Central Piedmont	A	5
	Cleveland	A	0
	Coastal Carolina	A	0
	College of the Albemarle	A	0
	Craven	A	0
	Davidson	A	0
	Durham	A	0
	Fayetteville	A	0
	Forsyth	A	0
	Gaston	A	1
	Guilford	A	8
	Haywood	A	3
	Isothermal	A	0
	James Sprunt	A	0
	Johnston	A	2
	Lenoir	A	4
	McDowell	A	6
	Nash	A	3
	Pitt	A	5
	Randolph	A	7
	Richmond	A	0
	Robeson	A	0
	Rockingham	A	0
	Stanly	A	0
	Surry	A	2
	Wake	A	1
	Wayne	A	3
	Western Piedmont	A	1
	Wilson	A	0
	TOTAL		**63**
Manufacturing Technology (Tool, Die, and Mold Making – A5030A)	Caldwell	A	0
	Central Carolina	A	6
	Craven	A	5
	Davidson	A	0
	Fayetteville	A	0

Degree Program	Community College	Degrees Offered (A=associate's)	Degrees Conferred (2005-2006, unless otherwise noted)
	Forsyth	A	0
	Wake	A	3
	Wilson	A	0
	TOTAL		**14**
Manufacturing Technology (A50320)	Central Carolina	A	0
	Central Piedmont	A	3
	Craven	A	6
	Davidson	A	0
	Edgecombe	A	3
	Guilford	A	0
	Isothermal	A	0
	Johnston	A	0
	Nash	A	0
	Richmond	A	0
	Wake	A	0
	Wayne	A	0
	Wilson	A	0
	TOTAL		**12**
Manufacturing Technology (Quality Assurance – A5032B)	Central Carolina	A	0
	TOTAL		**0**
Mechanical Drafting Technology (A50340)	Alamance	A	7
	Asheville-Buncombe	A	0
	Central Piedmont	A	0
	Cleveland	A	3
	Davidson	A	0
	Edgecombe	A	1
	Isothermal	A	0
	Piedmont	A	0
	Rowan	A	0
	Surry	A	4
	Wake	A	2
	TOTAL		**17**
	OVERALL TOTAL		**404**

Source: The North Carolina Community College System

*****Signifies that the program has been accredited by the Accreditation Board for Engineering and Technology (ABET), the recognized accreditor for college and university programs in applied science, computing, engineering, and technology.
http://www.abet.org/

#Signifies that the program has been accredited as a Federal Aviation Administration (FAA) sanctioned maintenance program.
http://www.faa.gov/education_research/education/student_resources/schools_universities/index.cfm

The Advanced Machining Center at Lenoir Community College – The Advanced Machining Center (AMC) is a part of Lenoir Community College located in Kinston at the Global TransPark's Education and Training Center. The AMC is a member of the

North Carolina Aerospace Alliance and, accordingly, the center is funded through a 1.9 million dollar Golden LEAF grant. The goal of the center is to provide state-of-the-art training in machining, metal forming, and computer-aided design (CAD) in order to produce a highly trained workforce for the region. Bobby Merritt, Lenoir Community College's Director of Industrial Training, says the center prepares students to enter a number of fields, but that they are particularly focused on producing graduates for the area's numerous traditional aerospace companies. Specifically, the center offers students a focus in either aviation manufacturing or general machining and manufacturing. Merritt goes on to say that one of the biggest current demands for graduates is in the manufacture of replacement parts for aging aircraft. Merritt says that the region's military bases simply cannot keep up with their parts demand internally, so they have to contract with area companies like Kinston's Workhorse Aviation to fill the gaps. In response, the AMC provides specialized, customized training for firms like Workhorse, helping those companies update their incumbent workforce, as well as, providing them with fresh graduates. However, companies like Workhorse aren't the only major employer in region in need of their graduates. Merritt says that the Cherry Point Naval Air Depot (referred to previously as Fleet Readiness Center East) in nearby Havelock, alone employs around 4,000 machinists. Merritt could not cite exactly how many graduates are coming through the program, but he did say that due to all the local demand, the students they do produce get "hired up just about as fast as we can get them out" (B. Merritt, personal communication, February 7, 2007).

Merritt also noted what an important role N.C. State, another Alliance member, plays in the center's work. He says, that as one would expect, all replacement parts have to go through a fairly rigorous certification process which can cost in the neighborhood of 75,000 dollars when you include materials, labor, and the time. Merritt says that regulatory hurdles have been a major barrier for more companies entering the market. However, he notes that N.C. State's expertise has really helped the center to streamline that process. Merritt concluded by saying that he thinks that traditional aerospace can be an even more meaningful part of eastern North Carolina's economy, but that the local industry will need more skilled workers to be able to grow further (B. Merritt, personal communication, February 7, 2007).

Center website: http://www.lenoir.cc.nc.us/advancedmachiningcenter/

T.H. Davis Aviation Center – The T.H. Davis Aviation Center is a part of Guilford Technical Community College in Greensboro. The center housed at the Piedmont Triad International Airport, offers degree, diploma, and certificate training in aviation management, aviation systems technology, and piloting. The piloting track is a two-year associate's degree program that prepares students to become professional pilots. The Center also has a working relationship with Embry-Riddle Aeronautical University in Daytona, Florida where students can transfer to continue their piloting training. The management track prepares students for jobs in aircraft dispatching, cargo/logistics operations, or even as airport managers. Finally, the aviation systems technology track produces graduates who are prepared to become FAA licensed mechanics with airframe and/or powerplant ratings. The Center reports that their systems technology graduates have been hired by every major airline, the Triad's own TIMCO, and NASA.

Center website: http://www.gtcc.edu/transportation/aviation.html

Institute of Aeronautical Technology – The Institute of Aeronautical Technology is a program administered by Craven Community College. The institute is focused primarily on providing specialized training in aviation maintenance and was founded due to the demand for skilled labor at the nearby Fleet Readiness Center East located at the Cherry Point Marine Corps Air Station. In fact, Craven Community College which is located in New Bern opened the new 24 acre campus in Havelock in order to more easily cater to the air station's needs. Included on the expansive new campus are 5 computer labs, 11 classrooms, a learning lab, and a career center. Along with its peer programs at Guilford Tech and Wayne Community College, the institute prepares its graduates to become FAA certified technicians.

Institute website: http://www.craven.cc.nc.us/about/deptserv/havelock/

Wayne Community College Aviation Program – Wayne Community College in Goldsboro also offers a program in aviation systems technology. Like its peer programs at Craven Community College and Guilford Tech, the Wayne program prepares students

to become FAA certified mechanics upon graduation. In addition to its curriculum program, Wayne also offers continuing education classes in aviation systems technology aimed at individuals who already have a background in aviation maintenance and repair, but who need specific training in route to becoming FAA certified.

Program website: http://www.waynecc.edu/aviation/

N.C. State – In addition to being the state's sole source of aerospace engineers, N.C. State is also serving as the academic resource center for the Aerospace Alliance. The school received 5.4 million dollars from Golden LEAF (discussed below) to establish a Center of Excellence for Certification that can help "aerospace companies become qualified to manufacture aircraft parts, help aerospace companies implement agile manufacturing technologies that allow for low-volume production, and to develop facilities for accelerated stress testing of aircraft parts" (N.C. State, 2005, par. 2). Also, the three faculty who are heading the Alliance work have reportedly been given authorization begin the early planning for a potential institute of maintenance science and technology that would also be housed at N.C. State. The school's relationship with Cherry Point MCAS actually predates the formation of the Alliance. In 2004, N.C. State entered into an agreement with the Fleet Readiness Center at Cherry Point to provide technical assistance to the center's engineering staff. That work was soon followed up by another arrangement where N.C. State faculty work with Cherry Point engineers on the various challenges associated with vertical lift aircraft like the V-22 Osprey. N.C. State's work with the Alliance soon followed (N.C. State 2005).

Program website: http://www.mae.ncsu.edu/undergrad/ae_about.html

Center for Integrated Technologies – The Center for Integrated Technologies (CIT) is part of Western Carolina University in Cullowhee. The center is also a member of the North Carolina Aerospace Alliance Initiative. CIT was brought into the Alliance because of its expertise in reverse engineering and rapid prototyping technologies which are capabilities of particular use to companies trying to manufacture obsolete replacement parts for aircraft.

Center website: http://cit.wcu.edu/

The National Institute of Aerospace (NIA) – The National Institute of Aerospace is a "non-profit research and graduate education institute formed by a consortium of research universities to ensure a national capability to support NASA's mission by expanding collaboration with academia and leveraging expertise inside and outside NASA" (National Institute of Aerospace, 2007, par. 1) . The institute, located in Hampton, Virginia, conducts cutting-edge research in a variety of aerospace areas including: aviation safety, flight systems, and air traffic systems. In conjunction with those efforts, NIA also offers advanced degrees in science and engineering through its network of nine university partners that includes: the College of William and Mary, Georgia Tech, Hampton University, Old Dominion University, the University of Maryland, the University of Virginia, Virginia Tech, and North Carolina's own N.C. State and North Carolina A&T. Specific sponsored programs offered at the two North Carolina schools include master's and doctorate degrees in electrical and mechanical engineering at North Carolina A&T and master's and doctorate degrees in mechanical and aerospace engineering at N.C. State. In addition, each of the North Carolina schools also houses a NIA-sponsored research center: the Center for High Confidence Cooperative Systems at A&T and the Center for Planetary, Atmospheric and Flight Sciences at N.C. State (National Institute of Aerospace 2007).

Institute website: http://www.nianet.org/

Aviation Programs at Robeson Community College – Robeson Community College in Lumberton has partnered with the University of North Dakota on an aero/space program. Students will begin their studies on campus at Robeson for the first two years and then transfer to the University of North Dakota in Grand Forks to finish their four-year degree. The program is offering students training in commercial aviation, flight education, air traffic control, and aviation systems management. The university's Aerospace Foundation, which sponsors the program, says they are trying to meet of the industry, particularly in the areas airport management and air traffic control. Robeson's facilities for the new program will be housed at Lumberton Regional Airport and are expected to

include space for aircraft storage, classroom space, flight training devices, a flight planning room, and an aircraft dispatch area.

Program website: http://www.robeson.cc.nc.us/UND/index.htm

Institutional Assets

Although they tend to get overlooked, institutional partners and intermediaries such as business associations can be crucial parts of an industry's success. In fact, much of the aero/space development that has occurred thus far in the State has been driven by various institutions and it is safe to say any further efforts will also include their hard work and expertise. Accordingly, this section is intended to provide detailed profiles of a majority of North Carolina's key aero/space-related institutions.

Golden LEAF Foundation – The Golden LEAF Foundation is a nonprofit corporation which was founded to receive and disperse one half of North Carolina's share of the funds from the master settlement with tobacco manufacturers. Specifically, Golden LEAF is focused on investing those monies in a strategic fashion in order to help previously tobacco-dependent areas transition into the New Economy. One such strategic initiative is the aforementioned North Carolina Aerospace Alliance Initiative. Mark Sorrells, Senior Vice President of Golden LEAF, believes that traditional aerospace, specifically, holds a lot of promise for eastern North Carolina – a region certainly in need of a new direction following the loss of much of its tobacco and manufacturing base in recent years. In particular, Sorrells says traditional aerospace has a lot of potential for small business growth in the region – especially, with respect to replacement part manufacturing. He goes on to say that the replacement part business is particularly well-suited for smaller firms because it tends to be a low volume/high mix type of operation. In other words, there are a lot of different parts needed, but few of them are required in huge batches, which makes such work unattractive to major assembly line type operations. Accordingly, Golden LEAF's goal with the Alliance is to help small businesses bolster their abilities to compete in that segment of the industry (M. Sorrells, personal communication, February 8, 2007).

Sorrells says Golden LEAF is attempting to do this by targeting three major areas: the availability of skilled workers, technical assistance, and financial assistance. According to Sorrells, the single biggest constraint for traditional aerospace manufacturing companies is a lack of qualified machinists. The problem is exacerbated by the fact that many of the existing machinists in the state are scheduled to exit the workforce relatively soon as they approach retirement age. Sorrells says Cherry Point MCAS, alone, employs around 4,000 machinists, but that 40 to 60 percent of them are scheduled to retire in the near future. Sorrells contends such unfilled losses could jeopardize the base's future altogether. Accordingly, the workforce component of Golden LEAF's mission is about helping small business and ensuring the soundness of a key piece of the state's valuable military presence. In response, Sorrells says that the foundation has funded advanced manufacturing centers at both Lenoir and Haywood Community College. Sorrells notes that the Haywood program is not yet up and running but that the Lenoir program, which is housed at the Global TransPark in Kinston, is operational and that its enrollment is up nearly threefold since its inception (M. Sorrells, personal communication, February 8, 2007).

In terms of technical assistance, the foundation according to Sorrells has enlisted the help and expertise of the college of engineering at N.C. State. N.C. State is wearing several hats in the effort, one of which being their work on the rapid reverse engineering process associated with replacement part manufacture. Companies often do not have the needed technical specifications required to reconstruct many of the replacement parts that are being demanded. In response, N.C. State is working on ways to help companies quickly reverse engineer the parts. Sorrells says the university is also helping companies with the rigorous testing and certification required on replacement parts (M. Sorrells, personal communication, February 8, 2007).

The third leg of Golden LEAF's aero/space stool is focused on providing companies financial assistance. Sorrells says there are a significant number of former military personnel who want to stay in eastern North Carolina and start their businesses, but that struggle to do so because of financial hurdles. Sorrells says one of the biggest issues is the lack of "patient" capital, basically meaning that potential investors aren't willing to

wait for the prospective business to get off the ground and hopefully start making a profit. Sorrells goes on to say that financial constraints also hamper the growth of many smaller, already existing aero/space firms in the state. Accordingly, Golden LEAF endowed the Neuse River Development Authority with a two million dollar grant to issue loans up to 250,000 dollars to new and existing aero/space businesses. Sorrells says the Neuse program is especially important because it provides companies with subordinated capital which allows firms to access traditional loans, i.e. working with banks, more easily (M. Sorrells, personal communication, February 8, 2007).

Foundation website: http://www.goldenleaf.org/

Aerospace Alliance Initiative – In April 2005, Golden LEAF awarded 9.3 million dollars – to be phased in over three years – to create the North Carolina Aerospace Alliance Initiative. The Alliance's primary goal is to equip North Carolina businesses with the ability to produce replacement parts for the fleets of aging aircraft at the state's military air depots, especially the naval air depot at Cherry Point and the U.S. Coast Guard repair and service center in Elizabeth City. The 9.3 million is being dispersed among three institutions who will help carry out Golden LEAF's mission. N.C. State will receive 5.4 million over the three-year period in exchange for engineering and technical expertise from their aerospace engineering school. Lenoir Community College will receive almost two million dollars to set up a worker training center that will be housed at the Global TransPark in Kinston. The remainder of the funds will go to the Neuse River Development Authority in order to develop a lending program for would-be manufacturers that might not qualify for conventional financing. Golden LEAF feels that the Alliance has the potential to tackle two of North Carolina's economic development challenges, namely, a lack of military-related business and the economic recovery of the eastern part of state following the loss of thousands of tobacco and manufacturing jobs.

More recently, the Center for Integrated Technology (CIT) at Western Carolina University in Cullowhee was added to the Alliance. CIT was added to the Alliance primarily because of the center's reverse engineering and rapid prototyping expertise. Phil Sanger, director of the center, noted that many of the parts needed by the state's

various military air depots are emergency replacements and, therefore, often times there is not time to wait for the standard, lengthy acquisition process. However, with CIT's reverse engineering abilities coupled with N.C. State's technical assistance, the Alliance is hoping to be able to supply the needed parts in a much quicker fashion (Western Carolina 2006).

Defense and Security Technology Accelerator (DTSA) – DSTA, located in Fayetteville, was created to help bolster the defense and security sectors in North Carolina. Specifically, DTSA is an incubator program that helps up and coming firms "with the rapid development (8 to 18 months) of dual-use defense and security technology solutions to meet military needs and private commercial demands" (DTSA, 2007, par. 1). DTSA provides entrepreneurs with lab facilities and office space, connections to resources at state universities and other "subject matter experts", and exposure potential partners in private industry. Furthermore, being located near Fort Bragg gives firms valuable access to the military marketplace. At full capacity the facility in Fayetteville can accommodate twelve to fifteen firms; however, DTSA also operates an affiliate program that can offer similar assistance to up ten firms statewide. As of December 2006, the incubator was reportedly 57 percent full. The creation of DSTA was spearheaded by the North Carolina Technology Association (NCTA) and the Partnership for Defense Innovation.

Accelerator website: http://www.dstanc.org/

North Carolina Military Business Center (NCMBC): In 2005 the state of North Carolina received just over one percent of total Department of Defense (DoD) annual procurements for the year, despite having the fourth largest military presence in the country in terms of personnel. In response to such a continuing disparity, the state formed the North Carolina Military Business Center (NCMBC) in 2005. The NCMBC, which is actually a part of the North Carolina Community College System, is a business development organization that helps North Carolina companies identify DoD-related business opportunities. Scott Dorney, Executive Director of the NCMBC, says the Center identifies around 2,000 opportunities per year and he notes that in 2006, NCMBC clients

won 160 contracts worth approximately 165 million dollars. Dorney goes on to say that the Center helps companies bid for contracts and keeps them abreast of general defense industry trends, but that it does not help firms write business plans. In terms of aero/space, Dorney believes that the state has a "pretty strong" aero/space presence. Specifically, he says the production of replacement parts for the state's various air bases has tremendous potential for the state. But, he goes on to say that effort, as well as the rest of the North Carolina's aero/space industry could be even stronger if the state can continue to reel in more DoD contracts. To do so, Dorney says the issue just needs more and more exposure throughout the state (S. Dorney, personal communication, February 8, 2007).

Center website: http://www.ncmbc.us/

Infrastructure Resources

Yet another key factor in determining the success of any almost any industry is the availability of required physical infrastructure. The key infrastructure component for the aero/space industry is transportation facilities. Accordingly, this section is intended to provide a full inventory of the industry's most important physical infrastructure category, namely airports, including an in-depth look at the Global TransPark in Kinston.

Airport Infrastructure – As evidenced by the HondaJet deal, airport infrastructure is a very critical component of the state's traditional aerospace industry. Specifically, small manufacturers, maintenance operations, and firms like HondaJet seem to be attracted to facilities that are somewhat off the beaten path in terms of major commercial traffic, but that still offer sufficient runway access and logistical support. Accordingly, this section attempts to identify such facilities in the state, as well as, examining the amount and location of scheduled air transportation activity in the state.

The Federal Aviation Administration (FAA) lists 409 total aviation facilities in North Carolina – 322 airports, 78 heliports, four stolports (airports with very short runways), three ultralight-only facilities, one gliderport, and even one balloon port. However, according to the FAA only 18 of that 409 are Part 139 certified, which is the approval needed for facilities that serve scheduled and unscheduled aircraft with more than 30

seats or that serve scheduled air carrier operations in aircraft with more than nine seats but less than 31 whom the FAA Administrator requires to have license (FAA 2007b). Furthermore, three of North Carolina's FAA approved facilities are military installations, effectively reducing the state's stock to fifteen.

Nonetheless, Table 2.6 examines some of the more important attributes of airports that have been identified in this analysis thus far, namely, runway facilities, room to grow, and repair operations. Additionally, Table 2.6 describes the pattern of scheduled air transportation in the state – a key, but somewhat less discussed segment of North Carolina's traditional aerospace industry. In terms of maintenance and repair, fourteen out of the fifteen facilities in the state were considered by the FAA to house major repair operations for both airframes and engines and the only one who did not, Asheville Regional, is said to have minor operations for both on site. With respect to scheduled commercial activity, Charlotte/Douglas – a U.S. Airways hub – is the clear leader in the state with roughly seven times the volume of second-place Raleigh/Durham International (RDU). The story is much the same in terms of air taxi operations as Charlotte/Douglas has about four and half times the volume of activity compared to second-place RDU.

However, such high levels of commercial volume are just the thing that companies such as HondaJet are reportedly trying to avoid. Consequently, places like Piedmont Triad International (PTI) in Greensboro with approximately $1/13^{th}$ of the commercial traffic of Charlotte become attractive destinations. PTI also meets most business's requirements with two lengthy runways, one of which is 10,000 feet. Additionally, at around 2,800 acres PTI does seem to have some room to grow, again, one of the attributes that was attractive to HondaJet. In fact, PTI appears to have become a highly attractive location for traditional aerospace activity in the state – the opening of the Comair regional facility there in January of 2006 made the airport home to at least thirteen maintenance and repair operations. And while not as populated, the Global TransPark in Kinston also shows some potential for expansion. It has significantly less commercial and air taxi traffic than most of the state's other facilities along with the second longest runway in the state – a further discussion of the TransPark is included below.

Table 2.6 – An Inventory of North Carolina's FAA Part 139 Certified Airport Facilities

Airport Facility	Location	Land Area (acres)	Commercial Activity	Air Taxi Activity	Airframe Repair	Engine Repair	Runways (feet)
Albert J. Ellis	Richlands	675	6,510	1,120	Major	Major	7,100
Asheville Regional	Asheville	900	3,109	8,615	Minor	Minor	8,001
Charlotte/Douglas International	Charlotte	5,000	246,034	235,498	Major	Major	7,502 8,676 10,000
Cherry Point MCAS	Havelock	---	---	---	---	---	7,553 8,108 8,984
Concord Regional	Concord	750	---	7,000	Major	Major	7,400
Craven County Regional	New Bern	660	6	8,581	Major	Major	6,004 4,000
Fayetteville Regional	Fayetteville	1,308	10,441	8,056	Major	Major	7,712 4,801
Hickory Regional	Hickory	739	5,199	---	Major	Major	4,400 6,400
Kinston Regional Jetport (Global TransPark)	Kinston	1,255	133	3,218	Major	Major	11,500
Moore County	Pinehurst	500	---	750	Major	Major	5,503 2,000
Piedmont Triad International	Greensboro	2,800	18,990	59,520	Major	Major	10,001 6,380
Pitt/Greenville	Greenville	872	2,555	12,500	Major	Major	6,500 4,997 2,687
Pope AFB	Fayetteville	---	---	---	---	---	3,000 7,501
Raleigh/Durham International	Raleigh	5,000	35,951	52,783	Major	Major	10,000 7,500 3,570
Rocky Mount/Wilson Regional	Rocky Mount	364	73	1,412	Major	Major	7,100
Seymour Johnson AFB	Goldsboro	---	---	---	---	---	11,758
Smith Reynolds	Winston Salem	702	672	3,314	Major	Major	3,938 6,655
Wilmington International	Wilmington	1,800	4,243	12,542	Major	Major	8,016 7,004
TOTAL		**23,325**	**333,916**	**414,909**			

Source: Federal Aviation Administration

Global TransPark (GTP) – Efforts to create the TransPark got underway in 1991 with the formation of the GTP Authority. The basic idea was to develop an international manufacturing and cargo hub that would put eastern North Carolina on the global map. Initial impact estimates projected that the TransPark would produce nearly 60,000 jobs

and 3.8 billion dollars in annual revenues for the state. However, roughly sixteen years later the TransPark has not lived up to its lofty expectations and has become in some quarters a poster child for giant, pie-in-the-sky economic development projects. Jennifer Russo, Marketing and Communications Manager for the TransPark, says the major challenge the TransPark has faced is the lack of transportation infrastructure around the facility. A look at any state map will quickly reveal that there are no major highways that run through Kinston, nor any direct access to a major port. Furthermore, Russo adds that the TransPark has no direct access to rail transport either – a fact she says has also been a major recent hurdle in recruiting firms to the site. Russo also says that the perceived quality of life in Kinston has hurt their efforts to recruit companies who were looking to relocate upper level management to the area (J. Russo, personal communication, February 12, 2007).

Nonetheless, in terms of traditional aerospace development, the TransPark does seem to have some potential. Currently, the 5,775 acre site is home to fourteen tenants, ten of which are private firms. Included in the ten is the aforementioned Workhorse Aviation whom specializes in the production of replacement parts for military aircraft, as well as, Seagrave Aviation who operates a sizable maintenance business in the park. In total, Russo says the TransPark is currently home to approximately 220 workers. However, the real value of the TransPark, in terms of aero/space development, is the facility's massive capacity for growth. Russo says the TransPark has a 300 acre industrial park with water and sewer already in the ground that is ready for immediate construction. Furthermore, the TransPark is home to the state's second longest runway of 11,500 feet – a length long enough to even accommodate a shuttle landing. The TransPark also has the resources to provide prospective and existing tenants with customized training. As mentioned previously, the TransPark is home to a state-of-the-art training center which houses Lenoir Community College's Advanced Machining Center (J. Russo, personal communication, February 12, 2007).

Innovation Activity

In trying to assess North Carolina's prospects for future aero/space industry growth, a key area to investigate is what, if any, related innovative activity is being performed in

the state. Accordingly, this section is intended to provide a brief overview of recent aero/space-related research and development that has been performed in the state.

Based on the analysis of the occupational data, and specifically the lack of aerospace engineer positions and educational programs, it might appear that North Carolina is not particularly active in aero/space-related research and development. Instead, most of the operations taking place in the state tend to be centered around the production end of the industry. Nonetheless, research and development is a very important and typically well-paying segment of any industry, so this analysis seeks to probe the issue further. In this section we gauge research and development activity in North Carolina by evaluating patent applications, an admittedly narrow way to measure innovation, but one for which data are readily available. Accordingly, the following analysis is not intended to be inclusive or particularly systematic.

The U.S. Patent and Trademark Office (USPTO) maintains an extensive database of all the issued patents since 1790 and all the patent applications filed since 2001. This analysis chose to examine the USPTO's patent application database in order to assess the amount of more recent aero/space-related research and development in the state. Two primary sets of parameters were used in the search. First, the database was searched for patent applications where the inventor's state was listed as North Carolina and the word aircraft was used in the application's abstract. The second search looked for applications where the patent's assignee state was listed as North Carolina and the word aircraft was in the application's abstract. The two searches were used to capture different phenomenon. Inventor state was used to highlight recent research and development activity that has actually taken place in the state, but not necessarily by North Carolina companies or individuals, whereas, assignee state was chosen to highlight research that is being sponsored by North Carolina-based companies or individuals, but is not necessarily being performed in the state.

The search for research and development performed in the state since 2001 did not reveal an overwhelming amount of activity – only 34 results were returned – but, it did highlight the work of one very important company. The LORD Corporation had six aerospace-

related patent applications on file, ranging from systems for absorbing helicopter vibrations to aircraft propulsion system monitoring devices. However, the really encouraging thing about LORD is that the company is actually headquartered in North Carolina. Located in Cary, the LORD Corporation is a diversified technology company with a rich history of developing cutting edge adhesive, coating, and motion management technologies. Using that expertise they develop various solutions for aerospace, defense, and automotive customers. Interestingly enough, LORD also operates an Aerospace Parts and Repair Station in Erie, Pennsylvania that produces high quality, remanufactured, and overhauled parts for fixed and rotary wing aircraft.

The application search based on assignee state yielded even fewer results than the inventor search – seven compared to 34 – however, it too highlighted one particularly active company. The Goodrich Corporation, headquartered in Charlotte and featured previously in this chapter – was the assignee of all seven aerospace-related patents on file. However, in contrast to LORD, all of the actual research and development work associated with those applications appears to have been performed outside of North Carolina – a result that makes sense given their large network of facilities located throughout the country.

Identical searches to those described above were also completed within the issued patents database with very similar results. However, one particularly interesting patent that was found was for a helmet restraint system developed by Speed Solutions in Statesville, north of Charlotte. The technology was described as having applications in stock car racing, as well as, aviation. Although, it is only a single patent, it does highlight some potentially interesting synergies between North Carolina's significant NASCAR presence and its aerospace companies. Similar searches were also completed in an effort to detect more commercial space-related work, but those efforts yielded even fewer results.

Findings Thus Far

The headlining result from chapter one was that the North Carolina Space Initiative's prior description of the state's *overall* traditional aerospace presence as "modest" seemed

to be a fair evaluation. However, the evidence presented this chapter seems to suggest that North Carolina's presence is more robust than previous assessments indicated.

Of particular note, is the fact that North Carolina is home to some leading aero/space development and production firms such as Goodrich, the LORD Corporation, Curtiss-Wright Motion Controls, and TIMCO among many others. Additionally, chapter one concludes that traditional aerospace is a well-paying industry. In fact, the data suggest that more often than not aerospace positions paid better than their non-aerospace equivalents at the state level. Furthermore, some segments of the state's traditional aerospace industry even tend to pay better than their counterparts in the national industry. This chapter does not present a real flurry of wage-related evidence; however, a couple of key examples, such as the Bridgestone plant in Mayodan and the Smiths Aerospace facility in West Jefferson, reinforce the notion that traditional aerospace opportunities do indeed pay better than the overall state average.

The third result from the analysis in chapter one is that North Carolina's traditional aerospace presence seems to be distributed throughout most of the state. In other words, almost all regions in the state seem to be benefiting from the aerospace industry. However, that finding was admittedly preliminary due to data suppression. This chapter investigated the issue further and found that the state's traditional aerospace industry is indeed active across the Tarheel state. Not surprisingly, the Charlotte region was found to have a strong corporate headquarters presence with Goodrich, General Dynamics ATP, and Curtiss-Wright Motion Controls all calling the Queen City their home. Additionally, Charlotte is also home to several key traditional aerospace production operations including two Goodrich facilities. The Triangle region, as would be expected, appears to be home to the bulk of the state's aero/space-related research and development and software operations. However, it should be noted that area is also home to a GE engine plant, one of the state's key traditional aerospace production facilities. As suggested in chapter one, The Triad region seems to specialize in aircraft maintenance and repair including but not limited to the dense cluster of operations performed at the Piedmont Triad International Airport. However, maintenance and repair is not the region's only specialization as Greensboro is now home to HondaJet which will mean an expanded

production presence in the Triad in addition to more research and development activity. The western part of the state, which was previously thought to be especially light in aero/space presence, was found to be a particularly active traditional aerospace manufacturing region evidenced by the three Smiths' engine plants in and around Asheville.

Yet, the most important finding in terms of geographic distribution was the story of eastern North Carolina. Based on the available numbers from chapter one, the eastern part of North Carolina has a significant traditional aerospace presence highlighted by strong manufacturing activity in the southeast. However, as this chapter reveals, eastern North Carolina is really the heart of the state's current traditional aerospace industry and might just be the key to any future expansion. Specifically, the story in eastern North Carolina with respect to traditional aerospace is its military presence. The eastern third of the state is home to four very important military aviation facilities. Elizabeth City is considered to be *the* home of Coast Guard aviation operations in addition to housing the Coast Guard's Aircraft Repair and Supply Center. The New River Air Station in Onslow County is considered to be the principal operating location for Marine helicopters on the east coast and Seymour Johnson in Goldsboro is home to the 96 F-15E Strike Eagles of the Air Force's 4th Fighter Wing. But, the crown jewel in North Carolina's traditional aerospace crown is without question the world-class Fleet Readiness Center East housed at Cherry Point Air Station in Havelock. In addition to being one of only six such facilities in the entire U.S. and a global destination for certain types of engine repair work, the Fleer Readiness Center with over 4,000 civilian and military employees is the largest single industrial employer in all of eastern North Carolina – a fact that by itself, in the opinion of this analysis, elevates the state's traditional aerospace presence beyond "modest".

However, the mere presence of those various military installations is not the reason for such adulation. Instead, the real value of eastern North Carolina's military aviation presence is its ability to act as a catalyst for current and future aerospace activity in the state. More specifically, the evidence presented in this chapter highlights at least five ways that the military's presence is particularly meaningful to the current and future

economic prospects of both the state's traditional aerospace industry and the overall economy of eastern North Carolina. First, as evidenced by the numbers from Cherry Point, military aviation is a major employer. Second, it is not just a major employer but it is a major employer in a key part of the state, eastern North Carolina, which is arguably the region of the state most in need of an economic boost. Third, the military facilities are an invaluable supply of skilled workforce. As was made clear in the first two chapters, skilled machinists are the occupational cornerstone of the state's traditional aerospace industry, yet, they seem to be in short supply. However, absorbing retired military machinists and other technicians into private industry helps to fill some of those existing workforce gaps. Fourth, the facilities' demand for obsolete replacement parts, as documented in this chapter, has become an engine for significant private sector activity including small business growth in eastern North Carolina. Finally, the extensive and often unique maintenance and repair operations occurring at the state's military aviation installations has bolstered innovative activity at North Carolina universities, headlined by the ongoing relationship between the military and N.C. State.

The fourth conclusion from chapter one was that despite somewhat underwhelming overall employment and establishment data, the state appeared to be fairly strong in engine and engine parts manufacturing, as well as, aircraft maintenance and repair and the evidence presented in this chapter certainly seems to confirm that notion. As mentioned, North Carolina is home to several major aircraft engine and engine part facilities, i.e., GE and Smiths. Furthermore, the state is indeed strong in maintenance and repair evidenced by the concentration of such activity in the Triad region in conjunction with the tremendous amount of maintenance and repair work being performed at the military facilities in eastern North Carolina. Moreover, the area of replacement part manufacturing, which bridges engine manufacturing and maintenance and repair, emerged during the course of this chapter as a third area of strength.

In addition to the numerous contextual details already discussed, this chapter also highlights the involvement of educational institutions and other relevant organizations. Institutions, whether they're educational or otherwise, are an all too often overlooked, yet, vitally important component of any industry, including traditional aerospace.

Specifically, the state's industry benefits tremendously from a very responsive community college system, evidenced by the recent program additions at institutions such as Craven Community College and Guilford Tech, among others. Furthermore, the work of the Golden LEAF Foundation, in the form of the North Carolina Aerospace Alliance, has been an invaluable part of the effort to bolster traditional aerospace business in eastern North Carolina. Additionally, institutions like the Military Business Center and the Defense and Security Technology Accelerator – while not strictly dedicated to aero/space – are especially important in terms of future development of the industry in North Carolina.

Accordingly, it is safe to then conclude that traditional aerospace is indeed a meaningful part of the current North Carolina economy and is particularly strong in several specific niches. However, as noted by the title of this study, current performance is really only half the question at hand. Accordingly, the focus of the discussion will now shift more towards assessing the long-run economic prospects of the industry.

The first part of that more speculative exercise is evaluating whether or not traditional aerospace would even be worth pursuing. In large part that issue has already been dealt with via all the reasons that have been presented thus far, i.e. good wages, presence throughout the state, and favorable industry mix. Furthermore, this analysis has shown that in addition to statewide appeal, traditional aerospace seems to hold particular promise for the state's least prosperous region, eastern North Carolina, because of the industry's relationship with the area's rich endowment of military assets. Additionally, this study contends that bolstering North Carolina's traditional aerospace industry could benefit not only the economic standing of eastern North Carolina, but also that such efforts have the potential to address two other state economic concerns. The first of these is that traditional aerospace has the potential to increase the amount of Federal defense dollars spent in the state. Second, it has the potential to weave the state's military installations even further into the fabric of their respective communities. In effect, this should help to shield North Carolina's valuable military assets from future rounds of BRAC closures and consolidations.

A second part of the discussion on future potential needs to deal with feasibility. To this point, it has been suggested that North Carolina has a meaningful presence in the industry and that there are a number of reasons why pursuing it could be beneficial, but that does not necessarily mean that the state's particular slice of the industry is well positioned for future growth. Yet, the evidence presented thus far at least suggests that North Carolina's traditional aerospace industry is indeed well-positioned for future growth. The primary reason for this statement is that the niches in which North Carolina has specialized are growing. For example, by all accounts the need for maintenance and repair operations, as well as, the demand for replacement part manufacturing will continue to grow as commercial and military fleets continue to age. In fact, industry forecasts expect domestic maintenance and repair revenues to exceed 55 billion dollars by 2015 up from 38 billion in 2005 – a predicted compound annual growth rate of 3.6 percent (Michaels 2006). Additionally, the recent addition of HondaJet in Greensboro instantly made North Carolina a leader in the budding very light jet industry – a market where some forecasts expect as many as 5,000 VLJs to be demanded by 2010 (Hirschman 2006). Furthermore, as discussed in this chapter, the state has developed a strong institutional framework, i.e. the Aerospace Alliance, new community college programs, the Military Business Center, etc., in recent years that can serve as a solid foundation for future traditional aerospace success. In summary, the industry seems to be ripe with potential and in the opinion of this analyst the industry's best days in the Tarheel state still lie ahead.

However, even though the traditional aerospace seems to have the potential to grow and become an important sector in North Carolina's economic base, the industry does face several challenges that will need to be overcome or resolved. The primary challenge that must be addressed is the availability of a quality workforce and, specifically skilled machinists. As discussed, the state's strength in terms of traditional aerospace is more towards the production end of the industry. As evidenced by the occupational analysis in chapter one and various interviews in this chapter, the key to continued success in that area is being able to provide companies with a stream of skilled machinists.

In this chapter, Mark Sorrells, Senior Vice President of the Golden LEAF Foundation, reported that the single biggest constraint faced by traditional aerospace manufacturing

firms is a lack of qualified machinists. Sorrells also noted that future of Cherry Point could be jeopardized by the base's inability to find skilled workers such as machinists (M. Sorrells, personal communication, February 8, 2007). That point was further reinforced by a 2005 interview with Smiths Aerospace human resource manager, Pam McIntyre. The Smiths' facility in Asheville hired 54 new workers, mostly machinists, in 2005, but, in order, to fill those positions the company was forced to do a nationwide search because as McIntyre said "we were not finding the workers we need in the local community" (Manning, 2006, par. 5). And even more recently, amid the announcement of another Smiths expansion in the Asheville area in March of this year, company spokesman, Dale Collins noted that the last thing the company needs to get operations up and running is skilled workers (Neal 2007). Complicating the issue even further is the fact that such skilled machinists are being demanded by numerous other industries at same time. In fact, according to the Employment Security Commission there were 176 employers related to skilled tooling and machining in western North Carolina alone at the end of 2005. However, the Commission also reported 354 unfilled machinists' jobs in region during that same period. Moreover, North Carolina Community College officials predict another 700 machinists' jobs will be created in the western part of the state over the next several years (Manning 2006).

However, the reason for the shortage does not appear to be a lack of compensation as the 200 new jobs created via the latest Smiths' expansion are all expected to pay well above the average wage for the region (Neal 2007). Nor does the dearth of skilled machinists appear to be due to a lack of training opportunities – as this chapter revealed there are 37 community colleges in the state offering related programs. Instead, the major culprit seems to be faulty perceptions about future demand. Sharon Morrissey, Vice President of Asheville-Buncombe Technical Community College, speculates that the persistent weakness experienced in manufacturing during recent years has led many prospective candidates to view machinist jobs as careers with little long-term potential (Neal 2007). That suspicion seems to be confirmed by the graduation data discussed in this chapter where only 63 workers were reportedly produced from the 37 community college programs during the 2005-2006 school year.

With that being said, the one area of this analysis that has not been discussed at any length is North Carolina's commercial space industry. First, it should be noted that this is not the result of a gross oversight. Instead, as mentioned previously, commercial space's absence thus far is due to the fact that it is almost entirely a question of future development. The issue of commercial space will be addressed in detail over the course of this report's final two chapters.

CHAPTER III. LESSONS FROM OTHER STATES

Up to this point, we have provided a comprehensive quantitative and qualitative profile of North Carolina's traditional aerospace presence. However, at this juncture in the analysis it is time to widen the scope in order to answer the following questions. First, this analysis wants to know whether or not the conclusions made thus far regarding the state's traditional aerospace potential are reasonable. Second, this study wants to finally develop an understanding of how the commercial space industry might play a role in North Carolina's economic future. In order to address these questions, this study will look for insights from the experiences of a select group of peer states that have already been down the road that North Carolina is now considering.

Three states – Georgia, New Mexico, and Virginia – were selected to serve as benchmarks. Each state was chosen in order to evaluate certain key questions that have arisen throughout the first three chapters. Georgia was selected first and foremost because a large portion of the state's traditional aerospace industry is focused around the existence of a major military asset, a very similar scenario to North Carolina's situation in the eastern third of the state. New Mexico was selected in order to examine the effort required to break into the burgeoning commercial space industry essentially from scratch. This is the same reality that North Carolina would face if the state decided to pursue such endeavors. Furthermore, New Mexico also provides some useful insights into the impact that HondaJet and the very light jet industry in general might have on North Carolina based on New Mexico's experience with the industry's leading producer, Eclipse Aviation. Finally, Virginia was chosen because it too offers a look at the commitment required to crack into the commercial space industry, as well as, some perspective on the intricacies of more general aero/space recruitment.

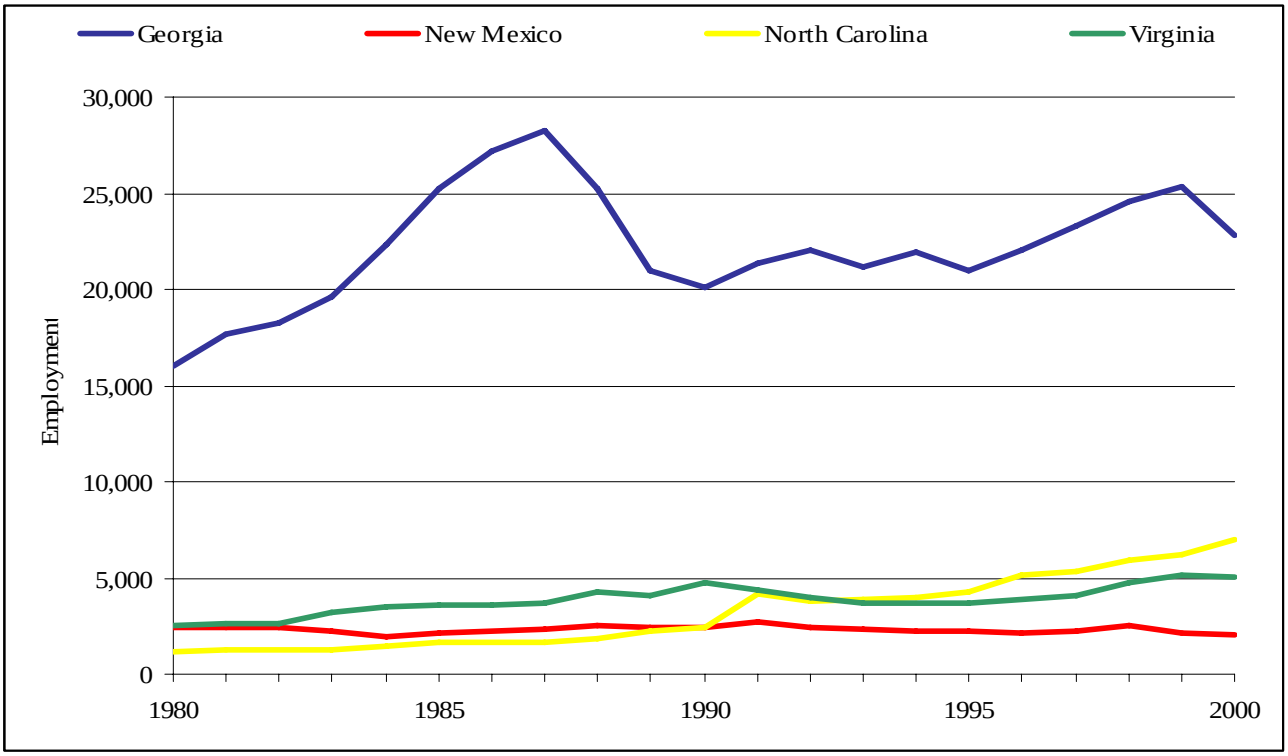
Development Trajectories

Before delving into the specifics of each state's experiences, we want to give the reader at least a general idea of how the aerospace industry has developed over time in each state. Specifically, Figure 3.1 looks at the growth of traditional aerospace employment in each

of the three benchmark states, as well as, North Carolina during the twenty-year span between 1980 and 2000.[14]

The first result of note from Figure 3.1 is that Georgia's aerospace industry, on the strength of its sizable manufacturing segment, was the largest among the four states as of the end of 2000. North Carolina's industry, which began the highlighted period with the smallest total, increased more than six-fold during the twenty-year span. As for the other benchmark states, Virginia's industry grew fairly steady between 1980 and 2000 as it tracked closely with North Carolina's path. New Mexico, on the other hand, saw its industry total decrease lightly during the twenty-year period.

Figure 3.1 – Development Trajectories of the Benchmark States' Traditional Aerospace Industry



Source: Bureau of Labor Statistics

[14] The information presented in Figure 3.1 is not directly comparable with employment figures discussed anywhere else in the report because it uses SIC data. Using SIC data, instead of NAICS, was necessary in order to conduct a time-series analysis (NAICS began to phase out SIC as the official U.S. employment classification system starting in 1997). Specifically, the figure displays the annual aerospace industry employment total for each state which is comprised from the totals of SIC 372 (Aircraft and Parts Manufacturing) and SIC 458 (Airports, Flying Fields, and Airport Terminal Operation).

Georgia

The state of Georgia was selected specifically to examine how its extensive maintenance, repair, and overhaul (MRO) industry is working together with the state's universities and military installations. As discussed previously, North Carolina is becoming quite active in the MRO sector and there is particular interest in coordinating that effort with the needs of the state's military facilities. Accordingly, Georgia is a good benchmark to explore.

Aerospace development in Georgia is primarily handled through the state's Aerospace Innovation Center (AIC) located in Warner Robins, Georgia. The AIC is responsible for coordinating the recruitment of new, complimentary aerospace companies, spearheading aerospace-related workforce development and K-12 programs, and working with companies and area universities on the development of new aerospace technologies. Georgia – the 8th largest aerospace state in the country – is home to a massive Lockheed Martin facility in Marietta that produces the F-22 Raptor and employs over 8,000 workers, as well as, Gulfstream Aviation in Savannah which produces the world's most advanced business jets and provides the state with another 4,300 jobs. However, the crown jewel in Georgia's aerospace crown is the Warner Robins Air Logistics Center. The logistics center is one of five such facilities in the country and is responsible for the worldwide maintenance, repair, and overhaul of three key pieces of the Air Force's fleet, namely, the F-15 Eagle, the C-5 Galaxy, and the C-17 Globemaster. The center, which is located on Warner Robins Air Force Base, employs over 19,000 people in "every critical discipline from avionics, to structures, materials science to system engineering and program management" (Aerospace Innovation Center, 2007, par. 2). Accordingly, the AIC is particularly interested in making sure that, in the end, all of their efforts enhance the strategic value of the logistics center.

Acting director of the AIC, Nick Fuhrman, is especially interested in the longevity of Warner Robins. Fuhrman believes that the kind of maintenance, repair, and overhaul activity done at Warner Robins and elsewhere in the state is a big growth area in the overall aero/space industry. However, he says there are two challenges facing the growth of MRO in Georgia and throughout the country, namely, the increased demand of

obsolete parts for an aging fleet of aircraft, as well as, potential workforce shortages. Fuhrman goes on to say that the AIC is working hard to address both issues. In terms of the obsolete parts, Fuhrman says that the AIC is focused on leveraging the expertise of Georgia Tech's aerospace engineering department in order to alleviate supply problems. Georgia Tech is actively working with Air Force officials at Warner Robins to not only produce replacement parts, but also to revamp out-of-date technologies with new solutions. Fuhrman hopes that this arrangement will also lead to numerous spinouts from the university and provide even more high-tech aero/space jobs for the state. Currently, he says there are five technologies being developed in conjunction with Warner Robins and even more are on the way. Additionally, the AIC encourages collaborations between the university and private aerospace firms in the state. For example, the Aerospace Innovation Center recently announced its first successful collaboration with a member company in March of 2005 when Greensboro's own TIMCO partnered with Georgia Tech's aerospace engineering department to infuse the principles of lean manufacturing into its maintenance, repair, and overhaul operations (N. Fuhrman, personal communication, January 31, 2007).

Fuhrman also notes that providing Warner Robins with the resources its needs only helps to further weave the base into the fabric of the community, hopefully shielding it from future rounds of BRAC closings and consolidations. In terms of the workforce, Fuhrman says the problem is two-fold. First, there is the issue of limited program availability at state technical and four-year institutions. He says that within the university system there are some related programs offered at a number of schools, but that Georgia Tech is really the main player in terms of producing the kind of technical professionals, i.e. engineers, demanded by the state's various aero/space companies. Second, Fuhrman suggests there is an even more fundamental issue which is the 'pipeline' problem. He says that more needs to be done to encourage kids in K-12 to explore aero/space as a viable career path. Fuhrman believes that aero/space has kind of gotten lost in the shuffle amid a flurry of other high-tech careers and that there needs to be major effort in the state to advertise the diverse set opportunities available within the industry. Fuhrman says that aero/space is especially important because it has room for both "wires and pliers" guys, as well as engineers. He adds that most all the potential career paths in aero/space are well-paying

because of the industry's tremendous quality requirements (N. Fuhrman, personal communication, January 31, 2007).

New Mexico

A seemingly unlikely peer, New Mexico was chosen because of their pioneering work aimed at becoming a global leader in space tourism, as well as, their efforts to attract traditional aerospace activity to the state. Their experience is particularly relevant to North Carolina for two reasons. First, their commercial space campaign is primarily a public venture, started from scratch – essentially, the same situation North Carolina would be facing if they decided to pursue the industry. Second, New Mexico is home to Eclipse Aviation which is the leader in the VLJ industry and a major competitor to Greensboro's HondaJet.

Clark Krause, President and CEO of the New Mexico Economic Development Partnership, says that commercial space was a natural fit for the state because of New Mexico's long history in the industry. Robert Goddard, one of the fathers of modern rocketry, spent much of the 1930s working on his designs in Roswell, New Mexico. Additionally, the New Mexico deserts were also the home to some of Wernher von Braun's rocket research following World War II. Currently, New Mexico is home to the White Sands Missile Range, which besides being the largest military installation in the U.S. (in terms of land area), is the premier missile range and test facility for the Army, Air Force, Navy, as well as NASA. NASA also refurbishes space shuttle components and completes some astronaut training at White Sands. Additionally, New Mexico is also home to Kirtland Air Force Base Research Laboratory, Sandia National Laboratory, and the Los Alamos National Laboratory – all of which in sum give the state a large military and research development presence to build an aero/space cluster around. Furthermore, Krause notes that New Mexico also offers ideal flying conditions including over 340 days of sunshine per year, very low air traffic, and relatively dry air which equates to lower fuel costs for commercial space launches (C. Krause, personal communication, January 31, 2007).

Aware of all of its unique assets, Krause says the state began to bolster its aero/space economy over twenty years ago. The state started by pursuing Lockheed Martin's Venture Star program. Krause says that the effort never materialized, but that the campaign got the state heading down the right road. The state finally landed its big fish in December of 2005 when Virgin Galactic – Richard Branson's company which intends to offer suborbital space tourism flights to the public – announced they would locate their world headquarters in New Mexico. Krause notes that the state aggressively pursued Branson and that Virgin eventually chose New Mexico from a list of global sites because of New Mexico's space history and the fact that the state presented Virgin with considerably fewer regulations and 'red tape'. With Virgin Galactic aboard, the state began to push for the development of a commercial spaceport. In January of 2006 state officials led by Governor Bill Richardson enacted legislation that provided for the construction of the world's first purpose-built commercial spaceport, Spaceport America. The state has reportedly committed 225 million dollars to the construction of Spaceport America which, as Krause notes, is not solely for Virgin Galatic's use. Instead, Spaceport America, which is operable now but is not scheduled to be fully completed until 2010, is really the foundation for the state's campaign to become a leader in commercial space transportation and space tourism. Krause goes on to explain that the spaceport is about more than just providing jobs. He says that the spaceport is also about inspiring the next generation of residents to become interested in space again and hopefully produce a future corps of severely needed engineers and other technical professionals. Krause says that next generation vision was a key part of selling the project to New Mexico taxpayers. He goes on to add that state officials, himself included, are keenly aware that this commercial space strategy has tremendous risks associated with it, but in the end, Krause says they feel from the governor on down that this is right path for New Mexico (C. Krause, personal communication, January 31, 2007) .

Part of their conviction is undoubtedly based on a series of economic impact studies that project the spaceport to generate over 2,300 jobs and over three million dollars in payroll by its fifth year of operation. Virgin Galactic, alone, is expected to employ around 400 people and Krause says his office expects scores of suppliers to follow as Virgin gets their operations underway. Reportedly, Branson already has some 45,000 people from

around the world who have expressed interest in being potential space tourists. Virgin Atlantic's suborbital flights, which only provide six minutes of actual weightlessness, are expected to retail initially for about 200,000 dollars. Virgin Galactic, hoping to have its first flight up as early as next year, is conducting its current operations at the Mojave Spaceport in California until its Spaceport America facility is fully completed. The eventual flights are expected to take place aboard SpaceShipTwo which is being built by Burt Rutan's Scaled Composites, LLC in California. This is the same company that built SpaceShipOne, the first privately-built and funded vessel to reach space (C. Krause, personal communication, January 31, 2007).

New Mexico has clearly dedicated a tremendous amount of resources to their commercial space pursuits; however, the state has also been very active in building up a strong traditional aerospace presence. Specifically, the state has made traditional aerospace one of its eight cluster targets. The centerpiece of state's traditional aerospace industry is Eclipse Aviation, the world-leader in very light jet (VLJ) design and production and a major competitor for Greensboro's HondaJet. Eclipse, which is located in Albuquerque, has been operating in New Mexico for close to five years after they were heavily recruited by the state. New Mexico viewed landing Eclipse as their big push into traditional aerospace and they pursued the company aggressively. In the end, the state successfully recruited Eclipse in a heavily incentivized deal that included the state taking a 25 million dollar equity position in the company (A. Talbot, personal communication, January 31, 2007).

Now, some five years later, Angela Talbot, Senior Business Development Manager with the New Mexico Economic Development Partnership, says Eclipse still has a very close working relationship with the state and the city of Albuquerque. Talbot says the current focus is on making sure Eclipse's workforce needs are being met. In doing so, the state built a 40,000 square foot training facility exclusively for Eclipse's use. Additionally, Eclipse is working very closely with the local community college to develop specialized curriculums that meet the company's workforce needs. Specifically, Talbot notes Eclipse is in particular need of people with high-end machining skills. Accordingly, Talbot says

almost all of Eclipse's 1,000 positions are well-paying because of the skill-intensive nature of the work (A. Talbot, personal communication, January 31, 2007).

Eclipse's facilities were initially located in the city of Albuquerque with low cost leases furnished by the city. However, Eclipse has since relocated to Albuquerque's smaller Double Eagle II Airport. Talbot says Eclipse chose the smaller facility because they could avoid the heavy volumes of commercial traffic typically found at major international airports, like Albuquerque's International Sunport. Talbot also notes Eclipse was attracted by the cheaper land and the fact that they just had "more room to maneuver" at the smaller facility. Currently, with Eclipse fully up and running, Talbot says the state is beginning to target many of Eclipse's suppliers in their current recruitment efforts as New Mexico looks to continue to expand its traditional aerospace presence (A. Talbot, personal communication, January 31, 2007).

Virginia

North Carolina's northern neighbor was chosen as a benchmark state because, like New Mexico, Virginia is engaged in both traditional aerospace activity as well as commercial space operations. However, it offers some slightly different insights than does New Mexico because its commercial space industry, which is a direct outgrowth from the state's NASA presence, offers a somewhat more sobering view of what it takes to establish a commercial space presence. With respect to traditional aerospace activity, Virginia provides an excellent example of how the industry can meet the needs of very diverse regions, similar to those in North Carolina.

Virginia is home to some the most important military facilities in the entire country. The Pentagon, headquarters for the U.S. Department of Defense, is located in Arlington, VA and Norfolk Naval Station, home to the Navy's Atlantic Fleet, is located Virginia's Tidewater region. Accordingly, Ralph Stephenson, the aerospace project manager for the Virginia Economic Development Partnership, says that the state is a natural draw for hundreds of defense-related companies trying to get their foot in the door at places like the Pentagon or NASA Langley in Hampton, the nation's first civil aeronautics laboratory. Stephenson says that list includes representation from nearly all of the

country's major aero/space companies including Boeing, Lockheed Martin, Northrop Grumman, General Dynamics, Rolls-Royce, and Airbus. Stephenson goes on to say that the majority of those firms' presence, especially around the northern Virginia and Tidewater areas, tends to be focused on the engineering and research and development segment of the industry (R. Stephenson, personal communication, February 2, 2007).

However, Stephenson is quick to add that aero/space in Virginia is not only about high-end functions clustered around federal government facilities. He says that the state is particularly fond of the industry because of its ability to provide good paying jobs to nearly all segments of the workforce. Specifically, he says aerospace is a good fit for the state's more rural areas, especially those locales that have lost much of their manufacturing base in recent years. Stephenson says that original equipment and replacement part manufacturers are particularly drawn to such areas because of the relatively inexpensive land costs and the presence of a workforce that can meet their needs without too extensive retraining. However, Stephenson notes that some upskilling is required in order for a smooth transition and that, unfortunately, some workers are reluctant to go through the necessary steps. He says that "old-school" mindset of "I'm too old to learn" can be a significant hurdle in providing aero/space manufacturers with the workforce they need. Stephenson asserts that the real key in trying to overcome such obstacles is the existence of strong, yet, flexible community college system that can tailor relevant offerings to displaced and incumbent workers. He says in his experience, computer skills have been the biggest area where workers have needed some fine tuning (R. Stephenson, personal communication, February 2, 2007).

In addition to rural areas, Stephenson says that smaller airports can be big draws for aero/space companies, especially small jet assembly operations. He contends that those companies enjoy being away from the busy hubs where they can have room to operate, but still have immediate access to runways. Stephenson says that most of these types of firms can be quite happy at airports with runways of between 3,500 and 5,000 feet. He does caution, however, that while such firms can be significant (50 to 100 jobs), well-paying employers, they can also be susceptible to shortages in operating capital which,

without some assistance, can jeopardize their longevity (R. Stephenson, personal communication, February 2, 2007).

Stephenson adds that the third main driver of aero/space industry in the state besides the federal government-related activity and the rural and small airport manufacturers is Virginia's universities. The state is home to three institutions actively involved in aero/space-related research, namely, the University of Virginia in Charlottesville, Old Dominion University in Norfolk, and Virginia Tech in Blacksburg. He says the state is constantly trying to facilitate partnerships between private companies and the universities. Additionally, Stephenson says that the universities, especially UVA and Virginia Tech, have produced numerous spinout companies that provide the state with even more high-tech presence in the industry. Most importantly though, Stephenson notes that the activity taking place at the three schools is always a big draw for aerospace companies who choose to locate in the Commonwealth (R. Stephenson, personal communication, February 2, 2007).

As mentioned above, traditional aerospace is not the only focus in Virginia. The state is also home to one of only six licensed commercial spaceports in the U.S. Virginia's facility, the Mid-Atlantic Regional Spaceport (MARS) at Wallops Island, however, offers a different view of commercial space development than does the previously discussed experience currently unfolding in New Mexico with Spaceport America.

Somewhat surprisingly, the Wallops Island flight facility, located on Virginia's eastern shore, is one of the oldest continuous launch sites in the world, having logged more than 15,000 flights during its history. The facility originally belonged to the Navy, but was transferred to the National Advisory Committee of Aeronautics (NACA), the precursor to NASA, in 1954 and from that point on NACA and then NASA have continuously occupied the facility. During the mid-nineties activity at Wallops diminished substantially as NASA suffered significant budget cutbacks, so much so that NASA officials even considered closing the facility. However, Dr. Billie Reed, director of the Virginia Commercial Space Flight Authority, knew what a resource Wallops was and was quite determined not to let it disappear. Accordingly, Dr. Reed worked with Old

Dominion University and the state's Center for Innovative Technology to develop plans to build a commercial spaceport at Wallops. The idea was to use the existing NASA assets and infrastructure already at Wallops to serve as the foundation of a commercial spaceport that could launch networks of small satellites into space. Eventually, the group received the state's blessing and formed the aforementioned authority in 1995 with Dr. Reed as the director. From there the authority pushed forward and signed an official lease with NASA in 1997 and constructed a 3.6 million dollar launch pad and made other necessary improvements the following year. The Virginia Commercial Space Authority owns the launch pad and operates the MARS spaceport on land leased from NASA who provides all the required technical and logistical support (B. Reed, personal communication, February 8, 2007).

Projections at the time of authority's formation in 1995 speculated that activity at the spaceport would provide around 300 jobs and more than 60 million dollars for the local economy within five years. But, as of November 2006, not one single rocket had been launched from the spaceport. Keith Kohler, a NASA official at Wallops, says the communications technologies the authority was banking on to drive business at the spaceport simply never materialized in a meaningful commercial fashion. In addition, Kohler notes that the satellites themselves and the corresponding launch vehicles were just too expensive at the time to make such operations feasible (K. Koehler, personal communication, February 6, 2007).

Nonetheless, Dr. Reed remains fairly optimistic about the facility's future. The spaceport gained a valuable ally in 2003 when the state of Maryland – whose state line is only four miles from Wallops – agreed to provide annual financial support to the authority. Additionally, the authority has been awarded several very large contracts during the past couple of years, including a 49 million dollar deal with the Air Force, in anticipation of launches tentatively scheduled to occur over the next five years. But undoubtedly, the spaceport's most encouraging moment occurred this past December when finally the first Minotaur I rocket carrying an Air Force TacSat-2 satellite was launched from the pad at Wallops. Moreover, the spaceport officials say there are three more launches scheduled for 2007 (B. Reed, personal communication, February 8, 2007).

Nonetheless, Dr. Reed is very quick to point out that it has been a long, tough road to get to this point and he strongly cautions other states thinking about getting into the industry to "temper their expectations" and be weary of building a white elephant. Dr. Reed adds that he is not just trying to stifle competition, but that he simply wants others to learn from his experiences. In fact, he contends that his MARS spaceport has a fairly unique niche, namely launching small satellites for the various federal government agencies located in and around Washington, D.C. and Norfolk, and says MARS is not really in too much direct competition with the numerous other spaceports that are coming online. As of the beginning of 2007, the FAA, the regulatory body in charge of issuing licenses to would-be spaceports, lists 6 licensed facilities – the Oklahoma Spaceport, the California Spaceport, the Mojave Spaceport also in California, the Kodiak Launch Complex in Alaska, the Florida Spaceport, and the MARS facility at Wallops. In addition, the FAA lists another 8 proposed spaceports including the Spaceport America facility in New Mexico. Dr. Reed says that many of those other existing and proposed spaceports might well be in direct competition with each other for a piece of a rather small commercial space pie, particularly with respect to space tourism dollars (B. Reed, personal communication, February 8, 2007).

In general, Dr. Reed notes that the commercial space industry is divided into two main parts: launching satellites as is done at Wallops and space tourism which is the primary focus of facilities like Spaceport America. Furthermore, each segment of the industry has its own unique set of facility requirements – a point Dr. Reed says is extremely important for prospective states to understand. For example, launching objects into orbit such as satellites generally requires that the launch site be located near water because during such operations items are jettisoned and from a safety perspective it is preferable that material land out of harm's way. Performing such launches over water also increases the chances of recovering jettisoned items if needed for testing or troubleshooting. On the other hand, space tourism which uses reusable vehicles does not necessarily need to be near water. However, tourism does require large tracks of land because of safety issues – hence spaceports focused more on tourism in places like New Mexico and Oklahoma where space is plentiful. Dr. Reed says space tourism could potentially be on MARS' radar screen, but again he cautions getting too far ahead of the times. Dr. Reed admits he is

skeptical just how quickly meaningful commercial space tourism and/or travel will occur. He cites launch vehicle reliability and full regulatory approval as the major roadblocks facing the future of space tourism (B. Reed, personal communication, February 8, 2007).

CHAPTER IV: CONCLUSIONS REVISITED

In this final chapter, the conclusions presented throughout the first two chapters will be reevaluated in light of the contributions from the benchmark analysis in chapter three. This chapter will be organized into the following four sections. The first two sections will employ the insights provided from peer states to reexamine North Carolina's standing with regards to traditional aerospace and the commercial space industry, respectively. The third part will distill the results of those two sections into a strength, weakness, opportunity, and threat (SWOT) analysis while the fourth and final section provides some brief, summary remarks.

Traditional Aerospace Conclusions Revisited

Traditional aerospace positions are generally well-paying: This finding was definitely confirmed via the benchmark analysis in chapter three. In fact, representatives from each of the three peer states interviewed explicitly stated that the aerospace employees in their respective states were generally well-paid, due in large part to the high quality work demanded in the industry. Furthermore, officials from Georgia and Virginia pointed out that traditional aerospace pays well across the employment spectrum from aerospace engineer all the way to machinist.

Traditional aerospace can provide employment opportunities for a diverse set of regions: One of the most attractive things about traditional aerospace through the first two chapters was the fact that the industry could benefit virtually every corner of North Carolina's diverse economic landscape, especially distressed regions like eastern North Carolina. Fortunately, that notion was reinforced in the benchmark analysis – especially in Virginia where traditional aerospace is meaningful part of the state's more corporate and research and development-focused areas, as well as, its more rural, production-focused regions.

North Carolina has a favorable mix of traditional aerospace industry segments: The first two chapters suggested that the state's existing strengths in traditional aerospace – engine and engine part manufacturing, replacement part manufacturing, and maintenance and repair – are growing segments of the industry and the evidence from chapter three

certainly seemed to confirm that idea. Specifically, Georgia officials noted that maintenance and repair is a rapidly expanding part of the industry and the testimonies of Virginia and Georgia officials both highlighted replacement part manufacturing as a business on the rise. Furthermore, based on New Mexico's experiences with Eclipse Aviation, it also appears that the very light jet market is poised for significant growth in the next decade or so – a particularly important finding given North Carolina's recent addition of VLJ producer, HondaJet.

The military is a key part of North Carolina's traditional aerospace industry: Despite employing an initial industry definition that explicitly excluded the military from traditional aerospace, the findings in chapter two made it abundantly clear that North Carolina's large military presence was a significant part of the state's current and future involvement in the industry. That assertion was strongly reinforced throughout the benchmark analysis, most notably in Georgia where a large part of the state's aerospace-related development efforts center around Georgia's seminal military aviation asset, Warner Robins Air Force Base in Macon.

North Carolina's rich institutional network plays a crucial role in the development of the state's traditional aerospace industry: Chapter two drew attention to North Carolina's existing network of aerospace-related institutions and emphasized how important they would be to any future development in the industry – a point that was also emphasized throughout the benchmark analysis in chapter three. Specifically, the testimonies from the three states tied the development of traditional aerospace to the involvement of three types of institutions. First off, the benchmark analysis underscored the importance of having a flexible community college system that can provide customized training and produce significant numbers of key occupations such as machinists. Second, the other states stressed the importance of university involvement in traditional aerospace in order to produce key segments of the workforce such as aerospace engineers, but also to act as a source of innovation for the industry. Finally, the benchmark analysis emphasized the significance of other dedicated aerospace institutions such as the Aerospace Innovation Center in Georgia which often help coordinate overall development efforts. More

generally, officials in all three states noted how important all three types of institutions are as a source of partnership and collaboration.

The future of traditional aerospace development in North Carolina faces several workforce availability challenges: Throughout the analysis it has become clear that North Carolina's traditional aerospace industry is facing several workforce-related constraints, including a lack of machinist production caused in large part by the negative connation associated with manufacturing careers. However, based on the testimonies of other states, North Carolina is not fighting those battles alone. Georgia and New Mexico both noted that skilled machinists are in high demand but short supply, while Virginia officials reported an unwillingness among displaced manufacturing workers towards obtaining the needed training that would allow them fill many of the machinist-type openings in the industry. Furthermore, the larger, more fundamental challenge regarding traditional aerospace's image was also brought up during the benchmark analysis. Georgia officials, in particular, expressed concern over how to get the generation of workers to view traditional aerospace as a viable career alternative. They suggest that the industry's attractiveness suffers from sustained weakness in manufacturing, as well as, an ever-increasing interest in other technology areas such as computers.

Finally, the benchmark analysis also highlighted another key point regarding the future expansion of North Carolina's traditional aerospace industry, namely, the importance of smaller, less busy airport facilities. That issue was raised in chapter two as a factor that had attracted HondaJet to Greensboro. However, its significance had been largely disregarded before the testimonies presented in the previous chapter. Specifically, officials in Virginia and New Mexico both emphasized the fact that smaller, less busy airports can be real engines of traditional aerospace growth. In North Carolina there are a number of such facilities headlined by the Piedmont Triad International (PTI) Airport, which, as mentioned, has become a real hub of aerospace activity in the state. However, at some point PTI is likely to run out of room or at least become busy enough that it loses some its initial appeal. Accordingly, the question becomes where else in North Carolina might such a hub emerge?

The answer, in the opinion of this analyst, is without question the Global TransPark in Kinston. As mentioned earlier, the TransPark has become widely considered a failed economic development investment. Yet given the apparent attractiveness of less busy airport facilities with ample for room for expansion and sufficient infrastructure, i.e. runways; this analysis thinks that the TransPark could still be a success story. The standard take on the TransPark is that it is a global logistics hub without good land or water access. However, based on all the facts presented thus far, this analysis believes the TransPark still has potential. In fact, this analysis contends that the TransPark's role has been miscast all along. For example, the TransPark gets hammered for its lack of transportation access. However, what is seemingly overlooked is that the TransPark can be reached by air, making it an attractive destination for all sorts of maintenance and repair operations. Furthermore, the TransPark is dismissed because it is in eastern North Carolina and far from any significant interstate. However, this analysis sees the location of the TransPark as a plus because eastern North Carolina is home to much of the state's traditional aerospace activity including all of the military aviation facilities, despite the lack of interstate highways. Additionally, the TransPark has a surplus of available space which in addition to housing maintenance operations could easily accommodate aircraft manufacturers the scale of HondaJet. Moreover, there is a state-of-the-art training facility on-site to handle workforce needs. We learned from the experiences of the benchmark states that less busy airport facilities with ample room to operate and lengthy runways are attractive sites for traditional aerospace companies and without question, the Global TransPark fits that description. Remarketing the TransPark as a facility well-suited to handle traditional aerospace functions as opposed to global cargo logistics could provide a much needed venue for the further expansion of the state's traditional aerospace industry, bolster eastern North Carolina, and make use of an existing asset that many people have already written off.

An Assessment of Commercial Space

Finally, it is time for an assessment of the commercial space industry's potential for North Carolina. As mentioned throughout this analysis, the commercial space industry is largely an emerging field whose uncertain potential is best evaluated via the experiences

of other states that have already begun their pursuit of the industry. That being said, this analysis offers the following observations regarding North Carolina's potential pursuit of the commercial space industry.

First and foremost, it must be understood that any effort aimed at developing a commercial space presence in North Carolina is a risky proposition. Officials in both of the active commercial space states evaluated, New Mexico and Virginia, openly admit they are taking a sizable risk. Furthermore, little of the enabling technology in either area of the industry, transportation or tourism, is well established. Second, the regulatory environment for both areas is largely undecided. Nonetheless, industry experts believe that private space operations will eventually happen. The real question is when. However, not knowing when is a big if when considering the sizable investment that is generally required to join the new space race – New Mexico has reportedly invested 225 million state dollars in their effort to get the Spaceport America off the ground. The central point here is that if North Carolina decided to pursue the industry, it would take a massive amount of precious state resources as up-front investment.

Third, it would take a significant amount of time to get up to speed. It has taken well over a decade for the Mid-Atlantic Regional Spaceport in Virginia to witness its first launch and Spaceport America in New Mexico is not expecting to send anyone into space until at least 2010. Meanwhile, the competition for a slice of an already thin commercial space pie is heating up. As of this year there are already six licensed spaceports in the country, as well as, another eight in the application process. Moreover, North Carolina would be facing a particularly steep learning curve given the paucity of space-related presence and/or facilities currently in the state. Virginia's decision to pursue commercial space was primarily a result of the existing NASA facility at Wallops Island. And while New Mexico did not have an existing spaceport per se, they did have a long legacy of space-related activity to build around. North Carolina, on the other hand, would essentially be starting from scratch.

Regardless, an attractive case could probably be made for commercial space in North Carolina, complete the same sort of gaudy economic projections that accompanied the

New Mexico proposal. However, we would like to point out that those same sort of projections were once associated with the promise of the Global TransPark, the same Global TransPark that nearly twenty years later is still trying to make its mark on the North Carolina economic landscape. In the end, we are agnostic about whether commercial space can be a significant economic activity in North Carolina; rather we are more concerned with making sure the would-be decision makers understand the full nature of the required commitment and the risks associated with such a decision.

A SWOT Analysis

STRENGTHS	WEAKNESSES
Traditional Aerospace: - Provides well-paying jobs - Industry presence throughout state - Particularly meaningful presence in eastern North Carolina - State is home to four unique military aviation assets, all of which are in eastern North Carolina - Strong network of aerospace-related institutions including the North Carolina Aerospace Alliance - Favorable industry mix in traditional aerospace including growing areas such as maintenance and repair and aircraft part manufacturing - Recent addition of HondaJet gives state an aircraft production presence - Strong traditional aerospace corporate presence in Charlotte including firms such as Goodrich - State has a flexible community college system that has added numerous aerospace-focused programs in recent years - Ongoing collaboration between N.C. State, private industry, and the military - The state has a long tradition with respect to a manufacturing and military presence	Traditional Aerospace: - A lack of aerospace-related research and development activity - Limited workforce production, particularly with respect to machinists and aerospace engineers - A lack of aerospace engineering programs - The recent negative image often associated with manufacturing careers Commercial Space: - A general lack of any space-related presence and/or facilities in the state
OPPORTUNITIES	**THREATS**
Traditional Aerospace: - HondaJet's place in the emerging very light jet industry - Traditional aerospace's potential to help the state increase its share of DoD dollars - Traditional aerospace's potential to help solidify presence of the state's invaluable military aviation assets - More small business growth/entrepreneurship opportunities stemming from replacement part business - Expanded future collaborations between state universities, community colleges, private industry, and the military - Potential spinouts from university-led aerospace research - Growth fueled by smaller, less busy airports such as Piedmont Triad International - An opportunity to turn the Global TransPark into a positive - Synergy between traditional aerospace development and more general efforts to grow state's defense and security presence - Potential to recruit more production operations to the state from companies already based in North Carolina, most notably Goodrich in Charlotte	Traditional Aerospace: - The very light jet industry not materializing as experts predict - Future rounds of BRAC closures and consolidations - Consolidations among major aerospace producers such as the possible merger/consolidation of Smiths Aerospace and GE Aviation - National and international competition in the future recruitment of traditional aerospace firms - National competition for aerospace workforce as evidenced by the University of North Dakota/Robeson Community College Program Commercial Space: - Tremendous amount of competition from other states who are getting involved in the industry and getting their spaceports off the ground - Delays in the development of commercial space-enabling technologies - Regulatory hurdles

Some Final Thoughts

Currently, neither traditional aerospace nor the commercial space industry are dominating fixtures on the North Carolina economic landscape. However, it has been shown throughout the course of this analysis that traditional aerospace does currently have a beneficial presence in state. The commercial space industry, on the other hand, has yet to arrive. The totality of the evidence presented suggests that traditional aerospace is capable of becoming a promising part of the state's economic future, while the commercial space industry appears to have a lower potential in North Carolina, a result due to the absence of any unique space-related assets to build around and other states having significant head-starts in the marketplace. As was evident from the benchmark analysis, development in either industry is largely dependent on an existing foundation of unique assets. For example, commercial space activity in Virginia occurred largely because of the presence of an existing NASA facility. Similarly, much of the traditional aerospace development efforts in Georgia have been inspired by the presence of Warner Robins Air Force Base. Yet, Virginia's experience with commercial space has still been a long, hard road toward any results even with a considerable head start. Unfortunately, North Carolina has no such leg up and, accordingly, any commercial-space related effort in the state would be from scratch, making for a very risky proposition with already scarce public economic development dollars. On the other hand, the state has a rich endowment of unique traditional aerospace assets, especially the various military aviation facilities in eastern North Carolina. In fact, traditional aerospace and the military or more generally the defense industry are so intimately intertwined in North Carolina that this analysis feels that the term aero/defense economy is a more appropriate descriptor than aero/space. Nonetheless, the ultimate point is that economic development efforts are more likely to be successful when they leverage existing strengths, not when they pursue the latest trend. That being said, the evidence presented throughout this analysis makes a strong case that suggests that traditional aerospace is indeed a strength in North Carolina. Accordingly, this analysis contends that any future effort to expand the state's traditional aerospace presence has the potential to succeed due to the solid foundation already in place.

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APPENDIX

Exhibit A: Community College Program Descriptions

Source: North Community College System

Aviation Management and Career Pilot Technology (A60180)

The Aviation Management and Career Pilot Technology curriculum prepares individuals for a variety of aviation and aviation-related careers including the commercial airlines, general aviation, the aerospace industry, the military, and state and federal aviation organizations.

Course work includes fundamentals of flight, aerodynamics, aircraft performance, meteorology, navigation, federal regulations, aviation management, and instrument and commercial ground training. Optional course work includes flight and simulator training or business management training.

Graduates will hold a commercial pilot certificate with an instrument rating or specialize in aviation management. Graduates may find employment as commercial, corporate, and military pilots, fixed base operators and airport managers, flight instructors, and flight dispatchers.

Aviation Systems Technology (A60200)

The Aviation Systems Technology provides individuals with the knowledge and skills to qualify for an aircraft mechanic's certificate with airframe and/or powerplant ratings. The curriculum is approved by the Federal Aviation Administration (FAA) under 14 CFR Part 147, which governs aviation maintenance schools.

Course work includes aviation mathematics, FAA regulations, basic electricity, aircraft drawings; aircraft structures, systems, and components; aircraft engines, theory, systems, and components; and engine inspections and maintenance.

Employment opportunities exist as entry-level mechanics with air carriers, manufacturers, repair stations, fixed base operators, flight schools, and government aviation operations.

Computer-Aided Drafting Technology (A50150)

This curriculum prepares individuals for employment as computer-aided drafting technicians. Graduates should be prepared for a wide variety of jobs that involve managing the hardware and software of a CAD system. Emphasis is placed on developing the student’s ability to interface with computer hardware and software in a CAD office.

Students will use CAD workstations to create and manage two and three-dimensional models for a wide variety of fields. Students will link CAD documents to other applications such as a database, GIS maps, spreadsheets, word processing, or CNC machining systems. Course work includes the study of drafting, computer hardware and operating systems, two- and three- dimensional computer models, solid modeling, rendering, and engineering systems.

Graduates should qualify for CAD jobs in a wide variety of fields that use computer-aided drafting technology. Job titles include CAD technician, CAD manager, CAD drafter and detail drafter.

Computer Engineering Technology (A40160)

The Computer Engineering Technology curriculum provides the skills required to install, service, and maintain computers, peripherals, networks, and microprocessor and computer controlled equipment. It includes training in both hardware and software, emphasizing operating systems concepts to provide a unified view of computer systems.

Course work includes mathematics, physics, electronics, digital circuits, and programming, with emphasis on the operation, use, and interfacing of memory and devices to the CPU. Additional topics may include communications, networks, operating systems, programming languages, Internet configuration and design, and industrial applications.

Graduates should qualify for employment opportunities in electronics technology, computer service, computer networks, server maintenance, programming, and other areas requiring a knowledge of electronic and computer systems.

Industrial Engineering Technology (A40240)

The Industrial Engineering Technology curriculum prepares graduates to perform as technical leaders in manufacturing and service organizations. The curriculum incorporates the study and application of methods and techniques for developing, implementing, and improving integrated systems involving people, material, equipment, and information.

The course work emphasizes analytical and problem-solving techniques for process development and improvement. The curriculum includes systems analysis, quality and productivity improvement techniques, cost analysis, facilities planning, organizational management, effective communications, and computer usage as a problem-solving tool.

Graduates of the curriculum will qualify for positions in a wide range of manufacturing and service organizations. Employment opportunities include industrial engineering technology, quality assurance, supervision, team leadership, and facilities management. Certification is available through organizations such as ASQC, SME, and APICS.

Industrial Management Technology (A50260)

The Industrial Management Technology curriculum is designed to equip students with the knowledge, skills, and abilities to function effectively in staff, front-line leadership, and mid-level management positions in organizations. The program emphasizes team building, TQM, SPC, motivation, continuous improvement, systems, and leadership.

Course work includes the integrated study of quality and productivity improvement, production operations, management, financial analysis, problem solving, and management of resources—human, physical, and information. Course work incorporates a broad understanding of computer applications to analyze and solve problems.

Graduates should qualify for entry-level positions such as front-line supervisor, engineering assistant, production planner, inventory supervisor, or as a quality control technician. With additional training and experience, graduates could become plant managers or production managers.

Industrial Systems Technology (A50240)
The Industrial Systems Technology curriculum is designed to prepare or upgrade individuals to safely service, maintain, repair, or install equipment. Instruction includes theory and skill training needed for inspecting, testing, troubleshooting, and diagnosing industrial systems.

Students will learn multi-craft technical skills in blueprint reading, mechanical systems maintenance, electricity, hydraulics/pneumatics, welding, machining or fabrication, and includes various diagnostic and repair procedures. Practical application in these industrial systems will be emphasized and additional advanced course work may be offered.

Upon completion of the curriculum, graduates should be able to individually, or with a team, safely install, inspect, diagnose, repair, and maintain industrial process and support equipment. Students will also be encouraged to develop their skills as life-long learners.

Machining Technology (A50300)
The Machining Technology curriculum is designed to develop skills in the theory and safe use of hand tools, power machinery, computerized equipment, and sophisticated precision inspection instruments.

Students will learn to interpret blueprints, set up manual and CNC machines, perform basic and advanced machining operations, and make decisions to ensure that work quality is maintained.

Employment opportunities for machining technicians exist in manufacturing industries, public institutions, governmental agencies, and a wide range of specialty machining job shops.

Graduates should qualify for employment opportunities in manufacturing industries and tool, die, and mold making industries.

Machining Technology/Tool, Die, and Mold Making (A5030A)
Tool, Die, and Mold Making is a concentration under the curriculum title of Machining Technology. This curriculum is designed to develop skills in the use of hand tools, computerized equipment, and precision instruments for machine tooling used for the mass production of parts.

Students will learn to interpret blueprints, set up manual and CNC machines, and perform basic and advanced machining operations. Emphasis will be placed on the production of tooling used for punching, stamping, and molding of parts.

Manufacturing Engineering Technology (A40300)
The Manufacturing Engineering Technology curriculum prepares individuals for employment in the fields of manufacturing technology. The curriculum emphasizes the theory and training required to effectively augment manufacturing engineers in industry.

Courses include a background in mechanical and related theory and the use of manufacturing and analytical equipment. Industrial standards such as EPA, OSHA, GD&T, and ISO are discussed. Computer usage for process control and effective communication skills are emphasized.

Graduates of this curriculum qualify for positions as engineering technicians. Some of the responsibilities include drafting, process specification, tooling selection, automation programming, project facilitation, and supervision. Certification is available through organizations such as ASQC, SME, and NICET.

Manufacturing Technology (A50320)
The Manufacturing Technology curriculum provides an introduction to the principles and practices of manufacturing in today's global marketplace. The student will be exposed to valuable high-tech concepts applicable in a variety of industries such as plastics, metals, furniture, textiles, and electronics.

Students will gain real-world knowledge in manufacturing management practices, manufacturing materials and processes, research and development, and quality assurance. Course work will include machining processes, CAD/CAM, CNC principles, and other computerized production techniques.

Graduates should qualify for employment as a manufacturing technician, quality assurance technician, CAD/CAM technician, team leader, or research and development technician. The student will be able to advance in the workplace and develop with new technologies.

Manufacturing Technology/Quality Assurance (A5032B)
Quality Assurance is a concentration under the curriculum title of Manufacturing Technology. This curriculum is designed to prepare individuals for employment in a variety of businesses and industries as entry-level quality technicians or to obtain specific skills in quality control or quality assurance.

Course work includes training in communication skills, mathematics, and all areas of quality management. Courses include statistics, statistical process control, quality systems auditing, ISO 9000, and quality manual preparation.

Graduates should be prepared to take the American Society for Quality Control Certified Quality Technician exam. They will have broad knowledge of modern quality systems and techniques as currently practiced today in business and industry.

Mechanical Drafting Technology (A50340)
The Mechanical Drafting Technology curriculum prepares technicians to produce drawings of mechanical parts, components of mechanical systems, and mechanisms.

CAD and the importance of technically correct drawings and designs based on current standards are emphasized.

Course work includes mechanical drafting, CAD, and proper drawing documentation. Concepts such as machine shop processes, basic materials, and physical sciences as they relate to the design process are also included. The use of proper dimensioning and tolerance techniques is stressed.

Graduates should qualify for employment in mechanical areas such as manufacturing, fabrication, research and development, and service industries.

Mechanical Engineering Technology (A40320)
The Mechanical Engineering Technology curriculum prepares graduates for employment as technicians in the diversified mechanical and manufacturing engineering fields. Mechanical Engineering technicians assist in design, development, testing, process design and improvement, and troubleshooting and repair of engineered systems. Emphasis is placed on the integration of theory and hands-on application of engineering principles.

In addition to course work in engineering graphics, engineering fundamentals, materials and manufacturing processes, mathematics, and physics, students will study computer applications, critical thinking, planning and problem solving, and oral and written communications.

Graduates of the curriculum will find employment opportunities in the manufacturing or service sectors of engineering technology. Engineering technicians may obtain professional certification by application to organizations such as ASQC, SME, and NICET.

Exhibit B: NAICS Traditional Aerospace Industry Descriptions

Source: U.S. Census Bureau

334511: Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
This U.S. industry comprises establishments primarily engaged in manufacturing search, detection, navigation, guidance, aeronautical, and nautical systems and instruments. Examples of products made by these establishments are aircraft instruments (except engine), flight recorders, navigational instruments and systems, radar systems and equipment, and sonar systems and equipment.

336411 Aircraft Manufacturing
This U.S. industry comprises establishments primarily engaged in one or more of the following: (1) manufacturing or assembling complete aircraft; (2) developing and making aircraft prototypes; (3) aircraft conversion (i.e., major modifications to systems); and (4) complete aircraft overhaul and rebuilding (i.e., periodic restoration of aircraft to original design specifications).

336412 Aircraft Engine and Engine Parts Manufacturing
This U.S. industry comprises establishments primarily engaged in one or more of the following: (1) manufacturing aircraft engines and engine parts; (2) developing and making prototypes of aircraft engines and engine parts; (3) aircraft propulsion system conversion (i.e., major modifications to systems); and (4) aircraft propulsion systems overhaul and rebuilding (i.e., periodic restoration of aircraft propulsion system to original design specifications).

336413 Other Aircraft Parts and Auxiliary Equipment Manufacturing
This U.S. industry comprises establishment primarily engaged in (1) manufacturing aircraft parts or auxiliary equipment (except engines and aircraft fluid power subassemblies) and/or (2) developing and making prototypes of aircraft parts and auxiliary equipment. Auxiliary equipment includes such items as crop dusting apparatus, armament racks, in-flight refueling equipment, and external fuel tanks.

336414 Guided Missile and Space Vehicle Manufacturing
This U.S. industry comprises establishments primarily engaged in (1) manufacturing complete guided missiles and space vehicles and/or (2) developing and making prototypes of guided missile or space vehicles.

336415 Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
This U.S. industry comprises establishments primarily engaged in (1) manufacturing guided missile and/or space vehicle propulsion units and propulsion unit parts and/or (2) developing and making prototypes of guided missile and space vehicle propulsion units and propulsion unit parts.

336419 Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
This U.S. Industry comprises establishments primarily engaged in (1) manufacturing guided missile and space vehicle parts and auxiliary equipment (except guided missile and space vehicle propulsion units and propulsion unit parts) and/or (2) developing and making prototypes of guided missile and space vehicle parts and auxiliary equipment.

481111 Scheduled Passenger Air Transportation
This U.S. industry comprises establishments primarily engaged in providing air transportation of passengers or passengers and freight over regular routes and on regular schedules. Establishments in this industry operate flights even if partially loaded. Scheduled air passenger carriers including commuter and helicopter carriers (except scenic and sightseeing) are included in this industry.

481112 Scheduled Freight Air Transportation
This U.S. industry comprises establishments primarily engaged in providing air transportation of cargo without transporting passengers over regular routes and on regular schedules. Establishments in this industry operate flights even if partially loaded.

Establishments primarily engaged in providing scheduled air transportation of mail on a contract basis are included in this industry.

481211 Nonscheduled Chartered Passenger Air Transportation
This U.S. industry comprises establishments primarily engaged in providing air transportation of passengers or passengers and cargo with no regular routes and regular schedules.

481212 Nonscheduled Chartered Freight Air Transportation
This U.S. industry comprises establishments primarily engaged in providing air transportation of cargo without transporting passengers with no regular routes and regular schedules.

481219 Other Nonscheduled Air Transportation
This U.S. industry comprises establishments primarily engaged in providing air transportation with no regular routes and regular schedules (except nonscheduled chartered passenger and/or cargo air transportation). These establishments provide a variety of specialty air transportation or flying services based on individual customer needs using general purpose aircraft.

488111 Air Traffic Control
This U.S. industry comprises establishments primarily engaged in providing air traffic control services to regulate the flow of air traffic.

488119 Other Airport Operations
This U.S. industry comprises establishments primarily engaged in (1) operating international, national, or civil airports, or public flying fields or (2) supporting airport operations, such as rental of hangar space, and providing baggage handling and/or cargo handling services.

488190 Other Support Activities for Air Transportation
This industry comprises establishments primarily engaged in providing specialized services for air transportation (except air traffic control and other airport operations).

517410 Satellite Telecommunications
This industry comprises establishments primarily engaged in providing point-to-point telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.

611512 Flight Training
This U.S. industry comprises establishments primarily engaged in offering aviation and flight training. These establishments may offer vocational training, recreational training, or both.

Exhibit C: Map of North Carolina's Regional Economic Development Partnership

Source: North Carolina Department of Commerce

Exhibit D: Map of Major North Carolina Airport Facilities

Source: North Carolina Airport Association